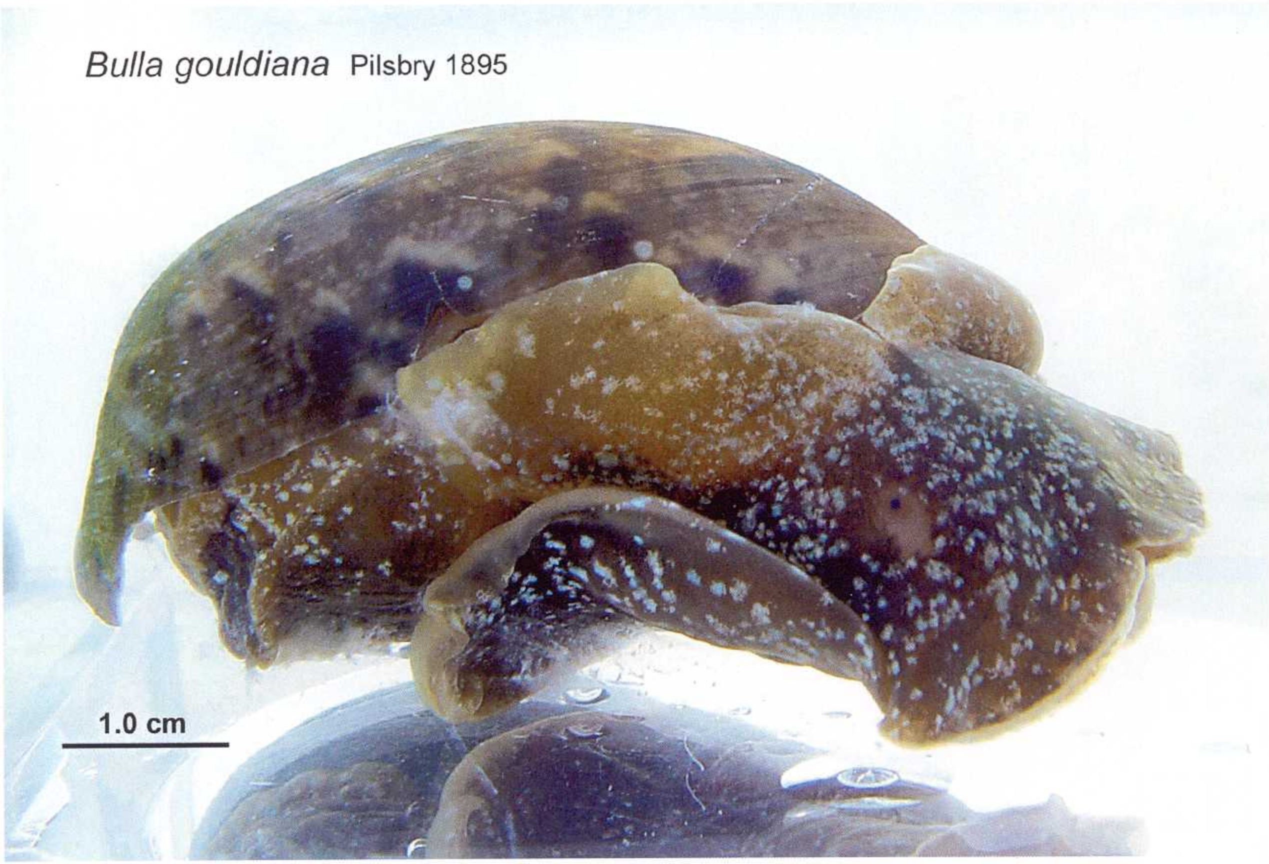
THE CITY OF SAN DIEGO

2003 QUALITY ASSURANCE MANUAL



OCEAN MONITORING PROGRAM

METROPOLITAN WASTEWATER DEPARTMENT
ENVIRONMENTAL MONITORING AND
TECHNICAL SERVICES DIVISION

600 B Street, Suite 500, San Diego, CA 92101-4587

QUALITY ASSURANCE MANUAL

CITY OF SAN DIEGO
OCEAN MONITORING PROGRAM

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CITY OF SAN DIEGO
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Technical Editor
Timothy Stebbins, PhD

Production Editor
Judes Brooks   Dean Pasko

Introduction
Timothy Stebbins   Dean Pasko

Laboratory Structure
Ricardo Amador   Mike Kelly   Dawn Olson   Laila Othman   Dean Pasko   Ron Velarde

Field Sampling Procedures
Ricardo Amador   Mike Kelly   Dawn Olson   Laila Othman   Timothy Stebbins

Laboratory and Analytical Procedures
Ricardo Amador   Dave Gutoff   Mike Kelly   Laila Othman   Rick Rowe   Ron Velarde   Lan Wiborg

Data Management
Dawn Olson   Dean Pasko

Results of Quality Assurance Procedures Conducted During Calendar Year 2003
Ricardo Amador   Adriano Feit   Mike Kelly   Diane O'Donohue   Laila Othman   Ron Velarde

Cover - *(Bulla gouldiana*)
Rick Rowe

Section Covers
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Introduction

City of San Diego
Metropolitan Wastewater Department
Environmental Monitoring & Technical Services Laboratory

INTRODUCTION

GENERAL INTRODUCTION

The Quality Assurance/Quality Control Program for the City of San Diego's Marine Biology and Microbiology Laboratories includes various practices that have been instituted to ensure the accuracy and reliability of receiving waters monitoring data reported to regulatory agencies. These QA/QC procedures assure the quality of field sampling, laboratory analysis, records keeping, manual data entry, electronic data collection/transfer, as well as data analysis and reporting. The procedures are reviewed and updated to reflect ongoing changes in sampling requirements, sample collection, methods, technology, and applicability of new analytical methods. Documents describing these and other procedures are maintained in accordance with Metropolitan Wastewater Department, Environmental Monitoring and Technical Services Division (MWWD-EMTS) ISO 14001 certification. An inventory of these documents is presented in Appendix A.

In addition to its regular ocean monitoring activities, the City of San Diego has participated in large scale regional monitoring projects that include measures to ensure the accuracy and consistency of data collected throughout the Southern California Bight (SCB). These regional projects require that both dischargers and regulators work closely together to define QA/QC procedures that will be used throughout the SCB. The participating agencies work to develop standard methodologies, rigid data reporting formats, and rigorous intercalibration exercises that meet the defined standards. Some of the procedures described herein have been adopted from these regional programs.

This manual provides a brief description of Marine Biology and Microbiology Laboratories structure and personnel, and includes information concerning field and laboratory protocols, sampling equipment, analytical techniques, training, as well as results of the QA procedures utilized in conducting permit mandated, contractual, and voluntary work. The protocols herein apply to all sampling and analyses performed by these laboratories and include detailed description of specific field and laboratory procedures reported in the Annual Receiving Waters Monitoring Reports for the Point Loma and South Bay Ocean Outfalls. The information in this manual is organized into four sections: (1) Field Procedures, (2) Laboratory Analytical Procedures, (3) Data Management Procedures, and (4) Results of Quality Assurance Procedures conducted during calendar year 2003. This information is submitted in compliance with requirements set forth in the National Pollutant Discharge Elimination System (NPDES) Permits for the:

(1) Point Loma Metropolitan Wastewater Treatment Plant – NPDES Permit No. CA0107409, Order No. R9-2002-0025, Addendum No. 1 adopted on June 11, 2003 (effective August 1, 2003).

(2) South Bay Water Reclamation Plant – NPDES Permit No. CA0109045, Order No. 2000-129 (effective September 13, 2000);

(3) International Wastewater Treatment Plant – NPDES Permit No. CA0108928, Order No. 96-50 (effective November 14, 1996).

LABORATORY STRUCTURE

The EMTS Division includes three laboratories that participate in the receiving waters monitoring activities associated with the above NPDES permits: (1) Marine Biology and Ocean Operations; (2) Marine Microbiology and Vector Management; and (3) Wastewater Chemistry Laboratory. The Marine Biology and Marine Microbiology laboratories are responsible for conducting the ocean monitoring activities described in this manual. Laboratory personnel are organized into technical work groups based on the major work responsibilities and areas of expertise. Brief descriptions of the areas of emphasis for each work group are given below. Descriptions of Marine Biology and Marine Microbiology laboratory organization, personnel, and personnel classifications are provided in Appendices B and C, respectively. Additional quality assurance procedures conducted by the Wastewater Chemistry Laboratory are presented in a separate report (City of San Diego 2004).

Marine Biology and Ocean Operations

Data Management and Reporting Group: The primary responsibility of the DM&R Group is the analysis and reporting of receiving waters monitoring data. This work includes data QA, data analysis, and the interpretation of results from the Ocean Monitoring Program and other contract work. Personnel from this work group work together with the IT/GIS Systems work group (described below) to perform QA of all receiving waters monitoring data that is entered into the laboratory's database. Members of the DM&R group use various tools to manage, manipulate, and analyze data from every aspect of receiving waters monitoring. These include software packages for data management (e.g., Oracle, Access), spreadsheet (e.g., Excel), statistical analysis (e.g., SAS, PRIMER), and data presentation (e.g., Sigma Plot, Microsoft PowerPoint). The interpretation of these analyses are reported to regulatory and contract agencies in the form of monthly, quarterly, semi-annual, and annual reports. Members of this work group work together with IT/GIS Systems work group in the final production and review of these regulatory reports.

Information Technology and GIS Systems Group: The IT/GIS Systems Group is primarily responsible for the administration of the lab's database and the analysis of spatial data. Daily responsibilities for the IT/GIS group include the archiving of sampling data, validation of data accuracy, the database structure and integrity, oversight of database access/security issues as well as enhancements to the database structure, and project planning/application development to support the needs of EMTS lab staff. This group is also responsible for timely and accurate data entry, spatial data analysis, GIS map preparation, and assembly and publication of reports. Monthly report publishing is performed entirely by the IT/GIS working group, while semi-annual and annual reports are produced as a cooperative effort with other lab personnel. Data QA/QC, statistical analysis, data interpretation and report-writing responsibilities are shared with scientific staff in the DM&R work group.

Ocean Operations and Toxicology Group: This group is comprised of three subsections, Ocean Operations, Toxicology, and Vessel Operations. The Ocean Operations section collects samples, maintains and calibrates oceanographic instrumentation, and conducts SCUBA diving and outfall inspection operations. They oversee water quality sampling, benthic sediment chemistry and infauna sampling, trawl, long-line, and diving operations, and Remotely Operated Vehicle (ROV) inspections of the ocean outfall. The Toxicology section is primarily responsible for coordinating sample collection and for conducting the required chronic and acute toxicity testing. They are also responsible for meeting the requirements for annual certification by the State's Environmental Laboratory Accreditation Program (ELAP) through proper maintenance of the Toxicology Laboratory, its instrumentation, all the accompanying records and manuals relating to testing activities and quality assurance. The Vessel Operations section is responsible for the operation and maintenance of the City's two oceanographic survey vessels, the 42' *Monitor III* and the 30' *Metro*. When in port, the Boat Operators schedule and oversee all of the regular vessel maintenance as well as any of the modifications that may become necessary. While at sea, they are responsible for ensuring the safety of the crew and for accurately locating and maintaining position at the sampling stations. The Boat Operators can also be called on to record station occupation data and/or assist with various deck activities during a variety of sampling operations.

Taxonomy Group: This group coordinates and manages the processing of all benthic infauna and trawl invertebrate samples, maintains the taxonomic literature and voucher collections, and conducts taxonomic training. In addition, they produce in-house species identification sheets and keys. Members of this group also participate in a regional taxonomic standardization program and perform all QA/QC procedures to ensure the accuracy of all taxonomic identifications made by laboratory personnel.

Marine Microbiology and Vector Management

Marine Microbiology Group: The Marine Microbiology technical staff prepares and sterilizes microbiological media, reagents, sample bottles, supplies and equipment. They also collect and transport ocean, bay, river and watershed samples to the laboratory for analysis. Professional staff performs membrane filtration (MF) analyses on seawater for total and fecal coliforms and enterococci. Multiple tube fermentation (MTF) analyses are run on wastewater and reclamation treatment plant effluents, treatment plant storm water runoff, membrane bio-reactors, DEH testing waters, and rivers for total coliform and/or fecal coliform bacteria. Colilert-18 and Enterolert chromogenic substrate analyses are used on the Mission Bay watershed and various special projects. The group is responsible for the physical maintenance and quality assurance of large instruments such as autoclaves, incubators, water baths, ultra-freezers, bacteriological safety cabinet and three reagent grade water point-of-use systems. Members are also responsible for developing sampling, analytical, and quality assurance protocols for special projects or studies involving microbiology.

Vector Management Group: Vector Management provides for monitoring, surveillance, control and prevention of insects and other pests that are capable of transmitting diseases or causing harm to humans. The primary methods of control include environmental conservation measures, education, and water management techniques aided by appropriate chemical and biological control technology. The vector control program uses methods to census animal populations to determine control effectiveness and trends. Areas of responsibility include Metropolitan Wastewater Department treatment plants, pump stations, buildings and office facilities. Biological assessment (bioassessment) of urban creeks and streams are conducted to evaluate and analyze short and long term impacts of sewage spills into watersheds and receiving waters. Field samples of aquatic communities are collected and field water quality indicators are measured. Physical habitat characteristics and anthropogenic changes are evaluated. Measures, evaluations, and comparisons are made to yield relative ratings of conditions within a specified community.

PROFESSIONALISM AND TRAINING

In order to ensure that city staff maintains a certain level of professionalism, training, and expertise, laboratory staff are expected to stay abreast of current scientific and statistical research. The internet allows for online research of electronic journals, libraries, and current research news, as well as the direct exchange of information, data, and taxonomic drawings and photographs with biologists and ecologists of other institutions. Various personal subscriptions to journals in the areas of taxonomy, marine biology, microbiology, data processing, ecology, and oceanography, and ISI Current Contents®/Agriculture, Biology & Environmental Sciences, a bibliographic resource, are also utilized to obtain contemporary information regarding all aspects of the program. In addition, employees are encouraged to access the library at the Scripps Institution of Oceanography and other educational centers to review literature relevant to the City's Ocean Monitoring Programs.

The Marine Biology Laboratory also maintains a library of references relevant to all phases of the Ocean Monitoring Program. Standard references on invertebrates, fishes, and oceanography as well as publications on standard field and laboratory procedures comprise about 200 volumes in the library, while the laboratory reprint file currently consists of over 6,300 titles. Unpublished material and manuscripts in preparation are also obtained through inquiries or contacts with marine biologists and oceanographers at academic institutions, government agencies, and private companies throughout the world. The library also contains a collection of survey reports pertinent to outfall monitoring. Surveys carried out prior to and after construction of the Point Loma outfall are included, as are many of the reports distributed by other marine dischargers and State agencies, such as the Department of Fish and Game and the State Water Quality Control Board. All references are catalogued in PROCITE, a bibliographic software program.

Laboratory staff are also encouraged to attend and participate in scientific and professional conferences in their area of expertise. These include the Western Society of Naturalists, Southern California Academy of Sciences, Crustacean Society, California Toxicity Assessment Group (SCTAG), Southern California Association of Marine Invertebrate Taxonomists (SCAMIT), among others.

Finally, general training required of all employees includes Laboratory Safety, Hazardous Materials Handling, First-aid and CPR, and departmental orientation. Additional training in various PC software packages, specific data analysis (e.g., SAS, PRIMER) and data base and data management software (Oracle, SQL) are also provided as new software is added or updates become available. MWWD's Safety and Training office provides training in other areas of management, safety, and computer software and staff is also encouraged to pursue training outside the City at local colleges and universities.

Field Sampling Procedures

Jack Russell, Sr. Boat Operator
on board Monitor III

FIELD SAMPLING PROCEDURES

The receiving waters monitoring programs include shore-based sampling to address water quality at bathing beaches and offshore sites to evaluate the fate of the wastewater plumes. The programs encompass a sampling area that extends from La Jolla, California to Playa Blanca, Mexico (**Figure 1** and **Tables 1 and 2**). The Marine Microbiology and Vector Management section is primarily responsible for managing the collection of the shore-based sampling, while the Marine Biology and Ocean Operations section coordinates the off-shore sampling program. The following section describes the quality control procedures used to ensure that samples are collected, processed, and transported according to a set of standard methods.

Logging Procedures and Sample Custody

Unique log numbers are assigned to each sample in order to facilitate sample tracking and data storage. An Oracle database application is utilized to complete the logging procedure. Depending upon sample type, log numbers are either assigned prior to sampling or when samples arrive at the laboratory. In either case, labels that include the following information are produced for each sample container: log number, station, sample date, sample depth (when appropriate), and either the sample type or the parameter(s) to be analyzed. Sampling report and chain of custody records are used to track samples through all phases of processing, which may involve outside contractors or other EMTS section laboratories.

Shore Station Samples

Strict QA procedures are followed during field sampling and sterile techniques are observed to ensure that bacteriological water quality samples are not contaminated. Water samples are collected in sterile 250-mL polypropylene bottles. The bottles are attached to a special sampling pole and dipped into the water with the bottle opening facing outward into the surf. When the sample is collected, care is taken to cap the bottle without contaminating the inner bottle or cap with the hands or fingers. The bottles are stored in a cooler and returned to the laboratory within six hours of collection for membrane filtration analysis.

Standardized field data sheets are used to record visual observations of surf height, weather conditions, wind speed and direction, human and animal activity, and the presence or absence and description of floatable, debris and plant materials. The Laboratory Technician responsible for that day’s sampling checks all data for completeness and accuracy before leaving a station. The Marine Microbiology supervisor reviews the field data sheets upon completion of each day’s sampling.

Offshore Samples

Navigation and Station Location at Offshore Stations

Two ocean monitoring vessels are use to conduct offshore operations and collect samples. *Monitor* III is a 42’, aluminum, twin diesel-powered, converted crew boat that is used for water quality sampling, trawls, SCUBA operations, ROV surveys and other special projects. *Metro* is a 30’ wood/fiberglass, gas-powered

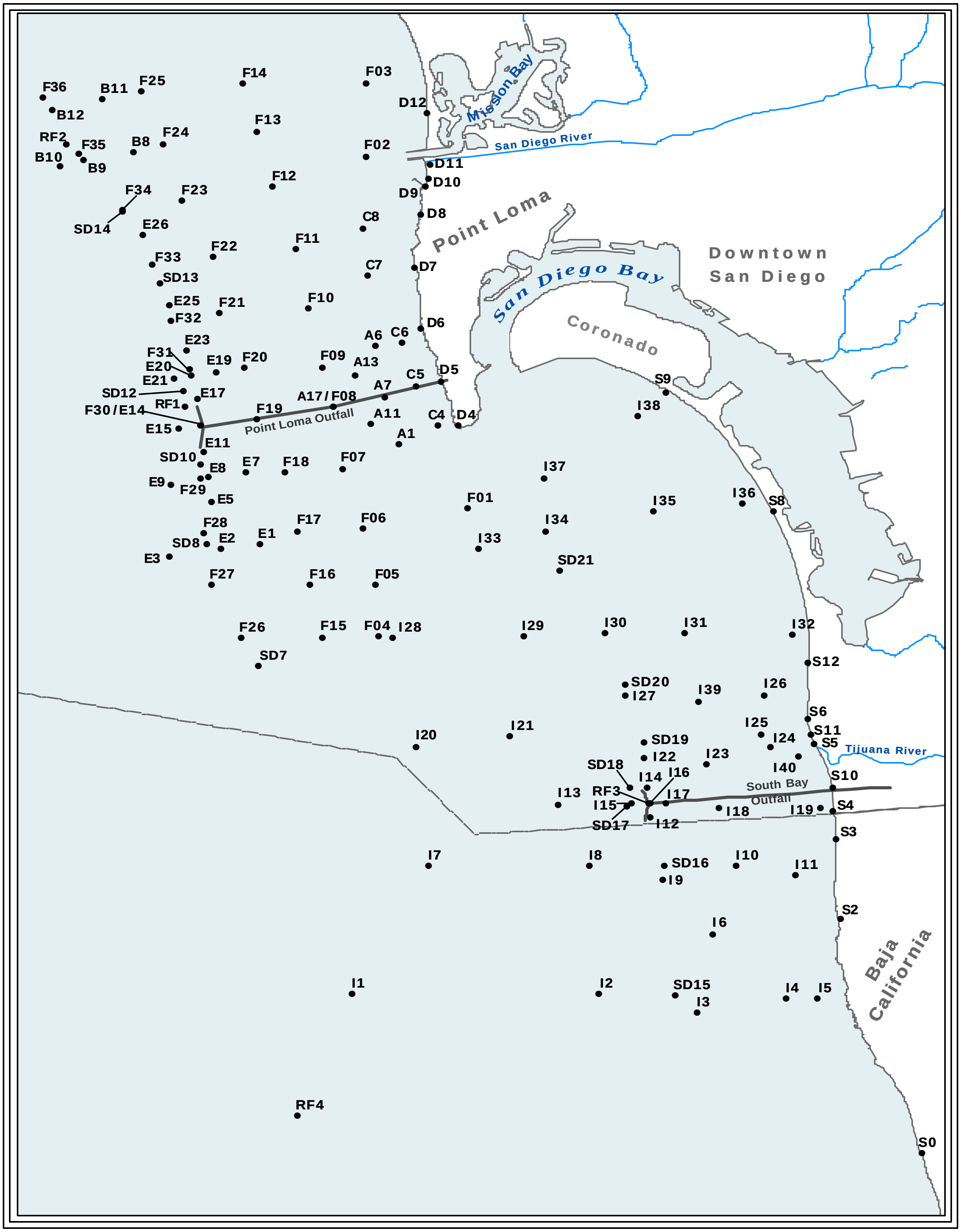


Figure 1

Receiving waters monitoring stations surrounding the Point Loma and South Bay Ocean Outfalls.

Table 1

Receiving waters sampling effort for the Point Loma Ocean Outfall monitoring program, excluding resamples or QA/QC (duplicate/split) samples.

Monitoring Component	Location	Number of Stations/Zones	Sample Type	No. Ocean Samples/Site	Sampling Frequency	Sampling Times/Yr	No. "Ocean" Samples/Yr	Parameters	No. "Data" Samples/Yr	Notes
Water Quality	shore (n=8)	8	Seawater - Bacti	1	weekly	52	416	T, F, E [a]	1248	1 sample/stn
Microbiology & Oceanographic Conditions	kelp (n=8)	8	Seawater - Bacti	3	5x/month	60	1440	T, F, E [a]	4320	3 depths/stn
		8	CTD	1	5x/month	60	480	CTD profile [c]	3840	1 cast/stn
	special study kelp (n=3)	3	Seawater - Bacti	1	5x/month	60	180	T, F, E [a]	540	Non-NPDES sites, bottom depths only
	offshore (n=36)	3	Seawater - Bacti	3	quarterly	4	36	T, F, E [b]	108	3 depths/stn (18-m stns)
		11	Seawater - Bacti	3	quarterly	4	132	T, F, E [b]	396	3 depths/stn (60-m stns)
		11	Seawater - Bacti	4	quarterly	4	176	T, F, E [b]	528	4 depths/stn (80-m stns)
		11	Seawater - Bacti	5	quarterly	4	220	T, F, E [b]	660	5 depths/stn (98-m stns)
		36	CTD	1	quarterly	4	144	CTD profile [c]	1152	1 cast/stn
Sediments	offshore (n=22)	22	Grab	1	semiannual (Jan, Jul)	2	44	sediment constituents [d]	396	1 grab/stn
Benthic Macrofauna	offshore (n=22)	22	Grab	2	semiannual (Jan, Jul)	2	88	infaunal community	88	2 replicate grabs/stn
Demersal Fishes & Megabenthic Invertebrates	offshore (n=6)	6	Trawl	1	semiannual (Jan, Jul)	2	12	fish/invert communities	12	1 trawl/stn
Bioaccumulation	offshore trawl (n=6 sites, 4 zones)	4	Trawl	9	annual (Oct)	1	36	tissue contaminants [e]	144	3 composite samples/ 3 species/zone (liver tissues)
Fish Tissues	offshore rig fishing (n=2 sites/zones)	2	Hook & Line/Trap	3	annual (Oct)	1	6	tissue contaminants [f]	24	3 composite samples/zone (muscle tissues)

a T, F, E = total coliform, fecal coliform, and enterococcus bacteria (n = 3 parameters); T, F, E = all NPDES mandated
b T, F, E = total coliform, fecal coliform, and enterococcus bacteria (n = 3 parameters); E = NPDES mandated, T & F = voluntary
c CTD profile = depth, temperature, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a*, pH, density (n = 8 parameters)
d Sediment constituents = sediment grain size, total organic carbon, total nitrogen, sulfides, metals, PCBs, chlorinated pesticides, PAHs, BOD (n = 9 parameter categories; see NPDES permit for complete list of chemical constituents; BOD = voluntary)
e Fish tissue contaminants (liver) = lipids, PCBs, chlorinated pesticides, metals (n = 4 parameter categories; see NPDES permit for complete list of chemical constituents); 3 metals analyzed (mercury, arsenic, selenium)
f Fish tissue contaminants (muscle) = lipids, PCBs, chlorinated pesticides, metals (n = 4 parameter categories; see NPDES permit for complete list of chemical constituents); 9 metals analyzed (arsenic, cadmium, chromium, copper, lead, mercury, selenium, tin, zinc)

Table 2

Receiving waters sampling effort for the South Bay Ocean Outfall monitoring program, excluding resamples or QA/QC (duplicate/split) samples.

Monitoring Component	Location	Number of Stations	Sample Type	No. Ocean Samples/Site	Sampling Frequency	Sampling Times/Yr	No. Ocean Samples/Yr	Parameters	No. Data Samples/Yr	Notes
Water Quality	shore (n=11)	11	Seawater - Bacti	1	weekly	52	572	T, F, E [a]	1716	1 sample/stn
Microbiology & Oceanographic Conditions	kelp (n=3)	3	Seawater - Bacti	3	5x/month	60	540	T, F, E [a]	1620	3 depths/stn
		3	CTD	1	4x/month	48	144	CTD profile 1 [b]	432	1 cast/stn
		3	CTD	1	1x/month	12	36	CTD profile 2 [c]	288	1 cast/stn
	offshore (n=37)	25	Seawater - Bacti	3	monthly	12	900	T, F, E [a]	2700	3 depths/stn
		37	CTD	1	monthly	12	444	CTD profile 2 [c]	3552	1 cast/stn
		28	TSS	3	monthly	12	1008	TSS	1008	3 depths/stn
		28	Oil & Grease	1	monthly	12	336	O&G	336	1 depth/stn
Sediments	offshore (n=27)	27	Grab	1	semiannually (Jan, Jul)	2	54	sediment constituents [d]	432	1 grab/stn
Benthic Infauna	offshore (n=27)	27	Grab	2	semiannually (Jan, Jul)	2	108	infaunal community	108	2 replicate grabs/stn
Demersal Fishes & Megabenthic Invertebrates	offshore (n=7)	7	Trawl	1	quarterly (Jan, Apr, Jul, Oct)	4	28	fish/invert communities	28	1 trawl/stn
Bioaccumulation *Fish Tissues*	offshore trawl sites (n=7)	7	Trawl	3	semiannual (Apr, Oct)	2	42	tissue contaminants [e]	210	3 composite samples/stn (liver tissues)
	rig fishing sites (n=2)	2	Hook & Line/Trap	3	semiannual (Apr, Oct)	2	12	tissue contaminants [e]	60	3 composite samples/stn (muscle tissues)
"Regional Survey"										
Sediments	random array (n=40)	40	Grab	1	annual (July)	1	40	sediment constituents [d]	320	1 grab/stn
Benthic Infauna	random array (n=40)	40	Grab	2	annual (July)	1	80	infaunal community	80	2 replicate grabs/stn

a T, F, E = total coliform, fecal coliform, and enterococcus bacteria (n = 3 parameters)
b CTD profile 1 = depth, temperature, light transmittance (transmissivity) (n = 3 parameters)
c CTD profile 2 = depth, temperature, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a*, pH, density (n = 8 parameters)
d Sediment constituents = sediment grain size, total organic carbon, total nitrogen, sulfides, metals, PCBs, chlorinated pesticides, PAHs (n = 8 parameter categories; see NPDES permit for complete list of chemical constituents)
e Fish tissue contaminants = total lipids, metals, PCBs, chlorinated pesticides, PAHs (n = 5 parameter categories; see NPDES permit for complete list of chemical constituents)

vessel that is used primarily for collecting water quality and benthic samples, SCUBA operations, and rig fishing. It is also used for projects where a shallow draft is required. Navigational equipment aboard *Monitor III* includes a North Star 961XD Global Positioning System (GPS) with 12 dual-channel differential GPS capability (DGPS) (8 meter accuracy), Trimble Navtrac DGPS (backup unit), Furuno FE-808 and FCV-663 depth-sounders, and a Furuno FR240-II radar unit. Stations are normally located using the DGPS and the depth-sounder. A North Star 961XD DGPS, Trimble Navtrac DGPS (backup), Furuno FCV-663 video depth-sounder, and Furuno 1751 radar are the instruments used aboard *Metro* for navigation and station locating.

Ocean Operations personnel routinely check the navigational equipment by comparing instrument readings against objects with fixed positions, such as Coast Guard buoys or the vessel's home dock. In addition, the latitude, longitude, and depth of the locations at which samples are taken are reviewed annually to ensure accuracy. The nominal station positions of the Monitor III and Metro's instrumentation systems are compared to each other and to the nominal station location provided in each NPDES permit (**Appendix D**).

Field Records

Standardized field data sheets are used to record data for water quality sampling, benthic sampling, otter trawl sampling, and rig fishing. These field sheets function to insure that all samples are collected and all parameters are measured and recorded. The Ocean Operations personnel in charge of that day's sampling checks data records and field sheets for completeness and accuracy before the boat leaves station. The supervisor of the Ocean Operations group reviews the field records and data sheets upon completion of each day's sampling. Original station occupation data are filed and maintained for at least five years.

Collection of Water Quality Samples

Whenever possible, a Seabird Electronics Inc., SBE-32 Carousel Sampler System is used for real-time water quality data and sample collection. The carousel sampler is equipped with an SBE-25 CTD and twelve 1.7-L Niskin bottles housed on a circular frame and integrated with a computer via slip ring mounted conducting winch. During sampling, the computer operator monitors the depth of the carousel as it is lowered through the water column and electronically closes each bottle at the required sample depth. Offshore water samples are sometimes collected using a davit and winch when the carousel sampler is getting serviced or is unavailable. At these times, discrete samples are acquired using 1 and/or 3-L Van Dorn bottles rigged in series on the winch cable. The bottles are arranged on the cable so as to collect the water samples at the required depths between the surface and the bottom with a single hydrocast when triggered closed by a weighed messenger.

Bacteriological water samples are drawn from the bottles into sterile 250-mL or 500-mL polypropylene bottles. The spigots on the bottles are allowed to run for a few seconds before the sample is taken to avoid cross-contamination. Samples containing resuspended sediments and kelp debris are discarded and resampled. Samples are refrigerated and returned to the Environmental Monitoring and Technical Services Laboratory within six hours of collection for processing.

Collection of Oil and Grease and Suspended Solids Samples

Water samples for oil and grease and suspended solids analysis are collected at pre-determined stations and specified depths in either 1.7-L Niskin or 3-L Van Dorn bottles. Upon return to the surface, suspended solids sub-samples are collected into plastic one-liter bottles. Oil and grease sub-sample is transferred to 1-L glass bottles and kept cool until transferred to the Wastewater Chemistry Laboratory. Sample replicates of suspended solids and oil and grease are collected at approximately 10% of the water quality stations. All of the oil and grease and suspended solids samples are transferred to the Wastewater Chemistry Laboratory for further preparation and storage until analyzed. Chain of Custody sheets are used to track the samples from the field to the Wastewater Chemistry Laboratory. Additional laboratory quality assurance procedures for these analyses are described in City of San Diego (2004).

Measurement of Transparency

Vertical water column transparency is measured with a Secchi disk, a weighted, circular, white plate with a standard diameter of 30 cm. The disk is lowered via a deployment line that is marked off in 5-m increments. The disk is lowered until no longer visible, and then raised slowly until it is barely perceptible. This depth reading is recorded to the nearest meter.

Water Column Profiling

A Sea-Bird Electronics, Inc. CTD (conductivity, temperature, depth) system is used for simultaneous profiling of chemical and physical oceanographic measurements required for monitoring of water quality. There are currently two CTD models in use. Typically, the SBE-25 CTD is used for routine sampling. The older SBE-9 CTDs are used as spares, or for special projects. An intercalibration exercise between all operational units is generally performed on an annual basis.

The CTD is a modular system consisting of the main electronic unit (fish) with conductivity, temperature, pressure, dissolved oxygen, and pH sensors as well as a submersible water pump mounted to the system. A description of the CTD system, including its specifications and calibration schedules for the integrated sensors, is provided in **Appendix E**. The pump improves water movement through the conductivity and dissolved oxygen sensor chambers enhancing their overall performance. In the event a sensor becomes inoperable or is otherwise damaged, all of the sensors are easily replaced with spares kept at the laboratory. The optical sensor components include a WETLabs, Inc. C-Star transmissometer with a 25-cm light path and a WETLabs Inc. WETStar chlorophyll (a) fluorometer. The SBE-9 CTD also includes a Sea-Bird Electronics, Inc. memory module (SBE-17) that allows the system to operate autonomously without an electrical connection to ship-board instrumentation. The memory component of the SBE-25 CTD is fully integrated into the main pressure housing.

The CTD systems are computer controlled. Data acquisition, data display, and sensor calibration are facilitated through a Sea-Bird Electronics, Inc. software package known as Seasoft.

The sensors are calibrated according to a schedule that conforms to factory recommendations and to the required water quality sampling schedule. The temperature, conductivity and pressure sensors are calibrated at Sea-Bird Electronics Inc. at regularly scheduled intervals. The results contain current calibration information as well as a historical comparison with previous calibrations. These historical comparisons are useful in providing data on the long-term stability of the sensors. Permanent records of the calibration information are retained at Sea-Bird Electronics Inc. Examples of calibration results are shown in **Appendix E**.

Macrofaunal Community Samples

A chain-rigged Van Veen grab, which samples 0.l m^2 of sediment surface, is used to collect benthic infauna. This sampler was recommended for use in outfall monitoring programs in Southern California by SCCWRP (Word, 1977 and Stubbs *et al*., 1987). The Van Veen grab was rated highly for its depth of penetration, lack of pressure wave on impact, and ease of use.

Several criteria have been established to ensure consistency of grab samples (see Tetra Tech, 1987). The surface of the sample should be undisturbed, and there should be no indication that the grab penetrated the bottom sediments at an angle. The following are considered acceptable minimum penetration depths for various sediment types (Tetra Tech, 1987): 4 cm for coarse sand/gravel; 5 cm for medium sand; 7 cm for fine sand; 10 cm for sandy silt and silty sand; 10 cm for silt; and 10 cm for clay. Samples showing improper penetration angle or depth, excessive leakage or other obvious abnormalities are rejected and the station is resampled. The Van Veen grab is brought on deck and placed into a rack located above a tray. Data concerning depth of penetration, grab temperature, station location and sea state are recorded on benthic field data sheets. The grab is then cocked open and the sediment is emptied from the grab into the tray. The grab is rinsed down to remove any remaining sediment adhering to the grab.

The tray is then emptied onto a wash-down table where the sediment is washed with a gentle stream of seawater into the sieve screen. The sediments are sieved through a 1.0 mm mesh stainless steel screen with a surface area of 1600 cm^2. Care is taken to avoid damaging animals on the screen surface when washing the sample and when transferring the retained organisms to the sample container.

After sieving is completed, all remaining material is transferred to plastic containers for relaxation prior to fixation. Samples are relaxed in magnesium sulfate and seawater. Containers are filled no more than one-half full with material, topped with $MgSO_4$ solution, inverted several times to distribute the relaxant, and are stored in a cooler or covered with a damp towel for approximately 30 minutes. After 30 minutes, buffered formaldehyde, (37% formaldehyde saturated with sodium borate), is added to the sample to achieve about a 15% formalin solution for fixation. A volume reference placard is included along with other field supplies to assist the field marine biologist in adding the appropriate amount of fixative. Large animals are removed and fixed separately. After 3 - 14 days of fixation in formalin the samples are rinsed in freshwater and preserved in 70% ethanol.

Sediment Quality Samples

Samples are also collected for sediment chemistry and particle size analyses using the Van Veen grab. These samples are taken from separate, non-infauna grabs, and they are collected from the top 2 cm of the sediment surface using polyethylene scoops. Each sample is handled according to EPA guidelines (Tetra Tech, 1987). Sample volume requirements and the containers they are stored in are provided by the City of San Diego Wastewater Chemistry Laboratory according to their quality assurance protocols (see City of San Diego, 2004).

Field replicates for sediment chemistry are taken at ten percent of the sampling sites during each seasonal sampling to ensure sampling consistency in the field. Replicate samples are collected from separate grabs and stored in containers with labels designating the special status. Details of the Wastewater Chemistry Laboratory quality assurance procedures are described in City of San Diego (2004).

Demersal Fishes and Megabenthic Invertebrates

Demersal fishes and epibenthic macroinvertebrates are collected using a semibaloon otter trawl with a 7.6 m head rope, 8.8 m footrope, 1.3 cm cod-end mesh and 22.9 m bridles. The typical trawl is towed for 10 minutes bottom time at approximately 2.0 knots along a predetermined heading that follows a particular depth contour. Trawl progress, position and time on bottom are monitored using a commercial onboard navigation integration and geographic information system (GIS) package called Mission Manager. A trawl cannot vary more than ± 10% from the target depth or pass farther than 100 m from the nominal station coordinates. Trawling position, depth and time are recorded on the Otter Trawl Field Record sheet during the course of the trawl. Ocean Operations personnel review these data at the end of each sampling day. Field personnel rigorously adhere to procedures detailed in Mearns and Allen (1978) and FSLC (2003).

Once the trawl net is brought on deck, the catch is sorted into major taxonomic categories of fish and invertebrates, placed in containers and subsequently identified to the lowest possible taxon and counted. Biomass information of each taxon is then collected by weighing each group in pre-weighed buckets with spring scales that have been calibrated in the morning. If debris is present in any of the trawls, it is described on the datasheet and the weight is recorded. All organisms are returned to the sea as quickly as possible.

If any particular identification is questionable, standard taxonomic aides are available onboard the vessel which can be used to identify the organism. If an animal cannot be identified confidently, a provisional designation is noted on the datasheet and the specimen is retained and returned to the laboratory for further examination.

Data on fish and invertebrate species abundance, fish size class and standard length, and biomass are recorded on the otter trawl field data sheets. Marine Biologists from the Data Management & Reporting group review the field data sheets at the end of each sampling event.

A voucher collection of every trawl fish species encountered is maintained at the laboratory as a reference resource. Each specimen is first fixed in formalin then transferred and stored in 70% ethanol along with the pertinent capture information. If the identification of any specimen is in question, it sent to an outside expert for verification.

Collection of Tissue Burden Samples

Various species of sport fish are collected for tissue burden analysis using rod, reel, and baited rock cod ganions (i.e., steel leader with 3 single-pronged hooks) at rig fishing stations. During the times when this technique is not productive, fish traps and/or anchored set lines (long-lines) can be deployed as a means of improving fishing success. Fish traps are large mesh cages that are baited with fish carcasses and then deployed, set on the bottom and marked with a buoy line. The trap is left to fish for times ranging between 3 and18 hours and then retrieved and the catch is processed. A long line is a nylon line equipped with small floats and a series of detachable, baited hooks and leaders which is stretched along the bottom between two anchors. The floats serve to keep the baited hooks elevated slightly above the bottom, and the hooks are spaced at approximately 2-m intervals along the entire length of the long line. Long lines are usually deployed for no longer than 3-hour periods to prevent predation of the target specimens by larger species.

Target fish collected by any of these techniques are measured, weighed, labeled, and the data are recorded on the appropriate field data sheets. The fish are then wrapped, along with their labels, in aluminum foil, put into Ziploc plastic bags, and placed on dry ice for transport to the laboratory freezer. Resected samples of muscle and/or liver tissues are obtained from the fish and subsequently delivered to the City of San Diego Wastewater Chemistry Laboratory for analysis within 30 calendar days of capture. Any fish targeted for bioaccumulation analysis that has not been processed and analyzed within this time limit is discarded.

Laboratory and Analytical Procedures

George Alfonso, Biologist II
Microbiology Laboratory

Microbiological Analyses

The Marine Microbiology Laboratory presently receives certification from the State of California Department of Health Services. Certification is approved as per the Environmental Laboratory Accreditation Program (ELAP) and consists of lab audits and proficiency testing.

Audits are on-site inspections that normally occur every two years or as determined by California DHS. They are designed to evaluate quality assurance and quality control of preparatory and analytical standard operating procedures, chain-of-custody and sample processing.

Proficiency testing is conducted by Environmental Resource Associates annually. The lab must successfully analyze performance evaluation (PE) standards for each field of testing and for each method that it is accredited for. The current certification is in effect until November 30, 2004 (**Table 3**).

The Marine Microbiology Laboratory follows guidelines issued by the United States Environmental Protection Agency (EPA) Water Quality Office, Water Hygiene Division, and the California State Department of Health Services, Water Laboratory Approval Group with respect to sampling and analytical procedures. The 20th edition of *Standard Methods* (Clesceri *et al*., 1998) and the EPA's *Microbiological Methods for Monitoring the Environment* (Bordner *et al*., 1978) are referred to for standard methodologies.

Heterotrophic Plate Count

The heterotrophic plate count (HPC) is used to estimate the number of viable heterotrophic bacteria in water. HPC analyses are run as needed on Treatment Plant process control samples and periodically on contract samples when specified. Results are reported as colony forming units per milliliter (CFU/mL).

Plate count agar (PCA) is the medium used for the HPC. A medium blank and 15 minute air plate are run with each set of HPC samples to test for medium sterility and ambient air contamination, respectively. When dilutions of the sample are needed in the analysis, an HPC plate is also run on a buffer blank to test for dilution buffer sterility.

Multiple Tube Fermentation

The multiple tube fermentation (MTF) analysis is used to statistically estimate the mean density of coliforms present in liquid or semi-solid samples. MTF analyses are run daily on samples from the North City Plant, monthly on samples of Point Loma Treatment Plant sewage effluent; and as required for treatment plant storm run-off water.

Laurel Tryptose Broth (LTB) is used as the presumptive medium and Brilliant Green Bile (BGB) broth is used as the confirmatory medium for the total coliform test. EC broth is the confirmatory medium used for the fecal coliform test. Tubes are generally set up in a 5-5-5 decimal dilution configuration. A most probable number (MPN) calculation is performed on the results and reported as MPN per 100 milliliters of sample (MPN/100mL).

Table 3

ELAP certifications for Environmental Monitoring and Technical Services Division Laboratory.

Laboratory	Address	Phone	EPA Lab Code	ELAP Cert. Number
Marine Microbiology	2392 Kincaid Rd. San Diego, CA 92101	619-758-2360	CA 01393	2185 (11/01/2002)
Bioassay	2392 Kincaid Rd. San Diego, CA 92101	619-758-2348	CA 01302	1989 (04/01/2002)

Escherichia coli is the positive control used for LTB, BGB and EC media and *Enterobacter aerogenes* is the negative control for EC medium. Media culture controls, media blanks, and buffer dilution water are run daily to test media performance, media sterility and buffer sterility respectively.

Membrane Filtration

The membrane filtration (MF) technique is used for enumeration of total and fecal coliforms and enterococcus in seawater samples. Bay and open ocean (shoreline, inshore, and offshore) station samples are filtered and incubated in the laboratory. Sterile 0.45 Fm membrane filters (Gelman) on glass or plastic funnels are used for filtering seawater samples. Total coliforms are enumerated on M-Endo LES agar (Difco), fecal coliforms on M-FC broth (Difco) and Enterococcus on MEI agar (Difco). Results are reported as colony forming units per 100 milliliters of sample (CFU/100mL).

As positive controls, *Enterobacter aerogenes* is used for M-Endo media, *Escherichia coli* is used for M-FC media, and *Enterococcus faecalis* is used for MEI media. As negative controls, *Pseudomonas aeruginosa* is used for M-Endo, *E. coli* for MEI and *E. aerogenes* for M-FC. Using *E. aerogenes* also serves as a test for water bath temperatures. Media controls are run with each set of coliform and enterococcus samples. In addition, a buffer and media control is run with each set. *E. aerogenes* is run for total coliforms and enterococcus. *E. aerogenes* is run with each set of fecal coliform analyses as a negative control to test water bath temperatures. About 10% of all positive or ambiguous colonies are verified according to EPA protocols. Colony counting, calculation of results, verifications and reporting of data all follow guidelines established by the EPA (see Bordner *et al*., 1978).

Colilert-18 and Enterolert (IDEXX)

Colilert-18 and Enterolert (IDEXX) are performed for the enumeration of total coliforms, *E. coli* and enterococcus. Results are given as MPN/100mL. The positive control for Colilert-18 is *E. coli* (taken from the local environment and identified using VITEK) for *E. coli* testing results, *Klebsiella pneumoniae* (ATCC #13883S) for total coliform testing results, and *Enterococcus faecalis* (ATCC #29212) for enterococcus testing results. *E. coli* and total coliform negative control is *Pseudomonas aeruginosa* (ATCC #27853). *E. coli* is the negative control for Enterolert. Colilert-18 and Enterolert analyses are performed on Mission Bay Watershed-Supplemental Environmental Project (MBW-SEP), the Tijuana River at Dairymart and Hollister Streets, coastal storm drains and other samples, as directed.

Vitek Verification

Verification of species-level identification of microorganisms is performed using the Vitek system, a special biochemical reaction card for the automated identification of microorganisms. The biochemical cards contain

29 wells of biochemical broth and one growth control. Media used in the cards are based on conventional biochemical tests, which have been adapted for use with the Vitek system. Identification usually takes 3 to 24 hours of incubation in the system's reader/incubator. The system's computer determines whether each well is positive or negative, and prints identification reports based on the reaction's results as compared to its comprehensive database of organisms. This QC is performed on samples analyzed using IDEXX and MF methods.

The family of organisms identified depends upon the cards being used. The Marine Microbiology Laboratory used the following cards:

Gram-Negative Plus (GNI +): for organisms of the Family Enterobacteriaceae.
Gram-Positive (GPI): for Streptococci, Staphylococci, and selected groups of gram positive Cocci.
Bacillus Biochemical Card: for microorganisms of the Family Bacillaceae.

Coliphage

The membrane filtration technique for coliphage is used for enumeration of male specific phage (MS2) in water samples. Coliphage contract work includes testing different membranes for the National Sanitation Foundation (NSF). The Department of Health Services (DHS) certification is run as defined by contract. This contract work involves seeding filtration units with coliphage and analyzing samples to determine the reduction of coliphage after the membrane. Sterile 0.45-Fm filters (Gelman) are utilized for filtering water samples. Filters are inverted and placed on tryptone agar plates and incubated. Results are reported as plaque forming units per 100 milliliters of sample (PFU/100mL).

The following controls are analyzed: a positive control, a negative control, buffer blank, medium, and a fifteen-minute air plate. Additional controls for the seeding analyses include a travel stock and a bottle blank. (Sobsey *et al*., 1990, J. AWWA 82:52-59).

Microbiological Quality Assurance Procedures

QA procedures suggested by the EPA and the State are followed and documented in all areas involved in microbiological testing. The following paragraphs cover some of the more noteworthy QA efforts in the laboratory.

A Millipore Milli-Q unit provides analytical grade deionized water for preparation of reagents and media. Prep room standard and Milli-Q treated deionized waters are analyzed daily for conductivity, pH, and total chlorine residual. Bacteriology lab standard and deionized waters are analyzed monthly for conductivity, pH, and total chlorine residual. A heterotrophic plate count for bacteria is performed monthly on Prep room standard and Milli-Q, bacteriology lab standard and deionized waters. Monitoring for airborne bacterial contaminants is performed whenever heterotrophic plate counts are conducted. A "Use for Evaluation of Reagents Water" test is run annually on standard and Milli-Q and Nanopure deionized waters. A "Test for Inhibitory Residues" is run annually to determine detergent and cleansing efficacy (Clesceri *et al.*, 1998).

Media are prepared from dehydrated stock according to EPA specifications (see Bordner *et al*., 1978). Each bottle of dry media is dated on the label when it is received and when first opened. These two dates, the date the bottle is discarded, lot number, expiration date, and accession number are recorded in a log which is kept in the media prep area. Both dehydrated and freshly prepared media are stored in a cool, dry, dark area. Each batch of prepared media is tested for pH immediately after preparation. Positive and media controls are run with each analysis. Buffer dilution water is tested for sterility by filtering two bottles from the batches in use through the filtration set-up and plating on M-Endo LES agar and MEI agar. These controls are incubated with the set of samples under analysis. A media preparation log is kept showing type of media, amount prepared, final pH and preparer's initials.

Stock cultures are ordered from Microbiologics and working cultures are inoculated every two months. A propagation log is kept indicating date of inoculation and stock culture information. Because of difficulties encountered when using ATCC cultures for *E. coli*, every two years (or as needed), a wild type strain of *E. coli* is identified using the VITEK. This strain is propagated and preserved with glycerol. It is subdivided into cryovials and stored in -80EC to serve as stock culture. This is also documented in the propagation log.

Records are kept of operation, calibration, and maintenance of all laboratory equipment. Maintenance contracts provide regular service for the autoclave, microscopes, balances, and bacteriological safety cabinets. Balances are checked prior to each day's media preparation against certified weight standards. Autoclave performance is documented with strip charts and verified with spore strip testing once per week. Autoclaved loads are identified with temperature sensitive tape on items in the batch. Autoclave run logs are kept showing the type of material run, length of sterilization run, and the operator's initials. Temperature records are kept daily for all refrigerators and drying/sterilizing ovens and twice-daily for all incubators and water baths.

Disposable petri dishes, pipettes, and culture tubes are used whenever possible to reduce the possibility of contamination from unclean glassware. Reusable glass and plastic lab ware are washed by an Amsco 470 Laboratory Glassware Washer in hot, soapy (Alconox "Det-o-Jet") water. The lab ware then goes through the following cycle: (1) 2-min tap water rinse, (2) 1-min wash, (3) 2-min tap water rinse, (4) 1-min tap water rinse, (5) 1-min tap water rinse, (6) 12-sec deionized rinse. An additional hand deionized rinse is performed on plastic ware. Glassware used in media preparation and sample collection is tested for soap residue by using bromthymol blue pH indicator solution and the results are entered into the appropriate log. Sample bottles are sterilized by autoclaving at 121^{o} C for 50 minutes. Sterility is verified by adding Tryptic Soy Broth (approximately 50:1) to a portion of the bottles which are then incubated at the appropriate temperature and humidity for 48 hours. After the incubation period, they are checked for bacterial growth and the results are entered into the appropriate log. If growth occurs, the entire batch is re-autoclaved. Three percent of the buffer dilution water is tested by adding 1.0 mL of the product water to approximately 10 mL of Nutrient broth medium which is then incubated at the appropriate temperature for 48 hours. The filter is placed on M-Endo LES agar (Difco, BBL) and incubated at 35^{o} C. After 24 hours the samples are checked for bacterial growth.

All bacterial plates are examined and recounted by a second analyst to assure accuracy of the recorded information. Discrepancies in original versus recount numbers of greater than 10% are discussed and resolved with the Microbiology supervisor. Calculations of bacterial density are checked and initialed by a member of the Microbiology Group who was not involved with the original counts or calculations.

Macrofaunal Community Analyses

Marine sediments on the southern California coastal shelf typically contain a diverse community of macrobenthic invertebrates that serve vital functions in the marine ecosystem (e.g., prey for larger organisms, help decompose organic matter). The structure of these communities is influenced by many factors including sediment conditions (e.g., particle size and sediment chemistry), water conditions (e.g., temperature, salinity, dissolved oxygen and current velocity), biological factors (e.g., food availability, competition and predation), and environmental stress. Because various species respond differently to environmental stress, macrobenthic assemblages have long been considered valuable indicators of anthropogenic impact (Pearson and Rosenberg 1978). Differences in communities are the result of spatial variation in the distribution and abundance of organisms and their affinity for and tolerance of different environmental conditions. Consequently, the assessment of benthic community structure is a major component of many marine monitoring programs, which documents both existing conditions and trends over time.

The accurate identification of benthic organisms is crucial to the subsequent community analyses. Accuracy of the identifications and analysis of the benthic infauna is facilitated by the following: (1) maintaining extensive literature and voucher collections, (2) promoting interagency standardization of taxonomic identifications, and (3) providing training which keeps pace with current advances in marine invertebrate taxonomy and benthic ecology.

Voucher Collection

A voucher collection consisting of approximately 1800 species that have been collected in grab and trawl samples is maintained in the laboratory. Each new species encountered is submitted to the Taxonomy Group for verification of identity, given an accession number, and added to the collection. If there is any doubt about the identification of a specimen, it may be sent to an outside expert. Soft-bodied specimens are preserved in 70% ethanol after fixation in 15% buffered formalin. Some mollusk and ophiuroid specimens are dried for preservation. The shells of larger mollusks are labeled directly. Small mollusks may be stored on paleontology slides. The fluid levels of vials in the wet collection are checked and topped off when needed.

Voucher specimens are curated by species. Information on each species in the voucher collection is entered into an Access database and includes accession number, taxonomic placement, specimen collection data, references and the name of the curator.

Interagency Taxonomic Standardization

In order to keep abreast of current taxonomic information and to develop consistency among all taxonomists in the Southern California Bight, City of San Diego marine biologists are active participants in SCAMIT: the Southern California Association of Marine Invertebrate Taxonomists. Since 1982, SCAMIT's programs have included monthly meetings involving interagency exchange of specimens, speakers on various taxonomic topics, literature exchanges, and workshops for examination of rare or problematical specimens. The organization produces a monthly newsletter that includes minutes of meetings, short abstracts of speaker topics, information on current reprint availability, results of interagency specimen exchanges, and voucher sheets of new species. During 1993, SCAMIT, under contract to SCCWRP for EPA, developed a master species list of marine invertebrates for the Southern California Bight. This species list was updated in 1995, 1998 and again in 2001 (see SCAMIT 2001).

Taxonomic Training

Members of the Taxonomy Group are responsible for all taxonomic identification training of laboratory personnel. When new information from the literature or from SCAMIT becomes available, it is passed on to all taxonomists. New species encountered in the monitoring program which typically include unusual, rare, and/or provisional species are made available for examination. The distinguishing characteristics of each species are discussed and pertinent references are distributed to the appropriate taxonomists. Provisional species are documented according to a specific format (**Figure 2**). Taxonomy workshops are scheduled as needed to review problematic organisms that merit special examination.

City of San Diego

PROVISIONAL SPECIES VOUCHER SHEET

Provisional Name: ***Notomastus* sp A**

Authority: SCAMIT 2001

Specimen(s): STATION DATE DEPTH STORAGE LOCATION VIAL#

Imaged specimen B-8 rep.1 7July97 290ft. DLZ Collection 222

Taxon: Capitellidae **Taxonomist: R. Rowe** **Date: 8May2001**

Common Synonyms: Erroneously referred to *Notomastus tenuis* Moore 1909 by SCAMIT.
See Related Species and Comments below.

Characters: Six specimens from City of San Diego Ocean Monitoring Progam were examined. All were similar in size to the specimen imaged on this page. Small size precluded observation of genital spores.

1. Thorax with 11 setigers with capillaries.
2. First setiger with notosetae only (uniramous).
3. Lateral organs visible in thorax.
4. Branchiae absent.
5. Prostomium with eyespots faded or absent but with well-formed palpode.
6. Genital pores not found on examined material (absent or too small to see).
7. Proboscis smooth, globular distally and papillated basally.
8. Methyl green staining pattern (see Fig.1):
   a. Anterior thoracic region unstained.
   b. Stain intensifies behind the setae on the 4th setiger and continues as solid stain or encirling bands through the 10th setiger.
   c. 11th (last thoracic) setiger lighter with little or only speckling of stain.
   d. Stain intensifies on the dorsum of the 13th setiger and continues through the abdomenas a dense, nearly solid band across the dorsum down to the neurosetal fascicles on each side. The only break in the stain is a thin band that encircles each segment at the setal fascicle.
   e. "Signature" stain is the paired midventral stripes that begin on the 13th setiger and continue back through the abdominals. (Other species might exhibit this stain.)

Illustrations:

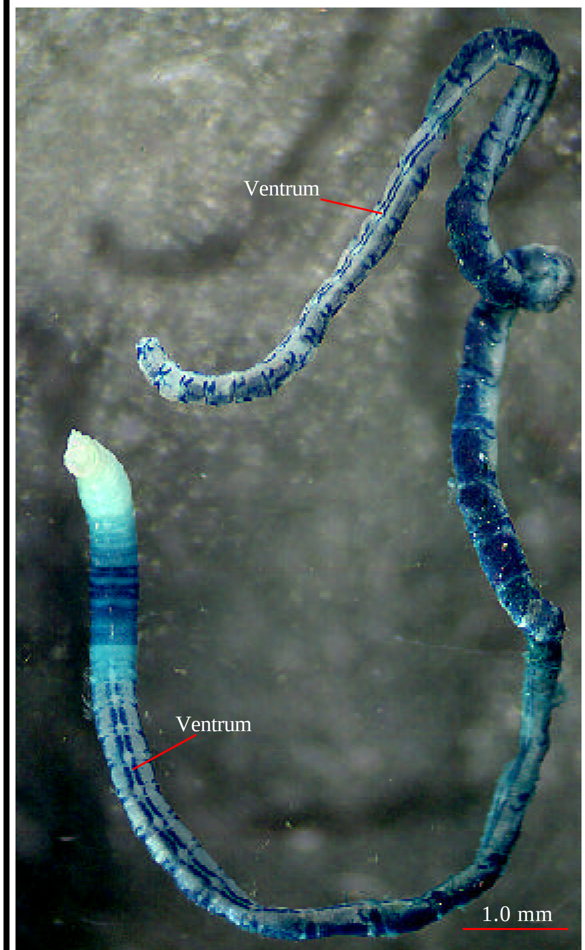


Fig. 1. *Notomastus* sp A SCAMIT, 2001
(methyl green stained)
original image R.Rowe 1997

Related Species & Other Comments:

This common species in S. Calif. monitoring programs has been misidentified as *Notomastus tenuis* Moore, 1909 in many studies. Leslie Harris observed (and methyl green stained) types of *N. hemipodus* Hartman 1945 and *N. tenuis* Moore 1909 and has suggested that we use a provisional name to replace our previous use of *N. tenuis* (see SCAMIT newsletter Vol. 18 No.1). Our specimens exhibit staining and other characters similar to the *N. hemipodus* types, but since that species is described from very shallow waters in North Carolina, SCAMIT has decided to use a provisional name for our deeper water worm until additional characters can be examined. *Notomastus* sp A SCAMIT, 2001 may be synonymous with *N. hemipodus* of Blake, 2000. Leslie Harris notes that the correct original description date for *N. hemipodus* Hartman is 1945, not 1947.

The holotype of *Notomastus tenuis* Moore, 1909 was collected on a sand bar in San Diego Bay. It is a valid species but does not exhibit paired midventral stripes of methyl green stain in the abdomen. Many species of *Notomastus* are inadequately described making differentiation of existing species and the recognition of new species difficult.

References:

Blake, J.A. 2000. Family Capitellidae *In*: Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel. Volume 7 The Annelida Part 4 - Flabelligeridae to Sternaspidae. pp.47-96

Hartman, O. 1947. Polychaetous annelids Part IV. Capitellidae. Allan Hancock Pacific Expeditions 10(4):391-481.

Figure 2

Example documentation of a provisional species identified by members of the Taxonomy work group.

Macrofaunal Quality Assurance Procedures

The quality of macrofaunal sample processing (i.e., sample sorting, species identifications and enumerations) is checked according to specific guidelines (i.e., Bight'98 Steering Committee, 1998; Bight'03 Benthic Committee, 2003). These documents describe quality assurance procedures for sample treatment and storage, removal of all organisms from the sample debris (sorting), biomass determinations, and species identifications and enumerations. The general flow of benthic sample processing and the points at which QA checks are applied are presented in **Figure 3**.

Resorts

The first step in processing a benthic sample is to sort the animals from the sediment and debris. This work is contracted to an outside laboratory. At least 10% of the samples sorted by each contract analyst are sorted a second time by City marine biologists to determine whether the established quality assurance standards (not more than 5% of the total abundance of animals missed) were met. The results of these resorts are reported on a worksheet. If a sample exceeds the 5% standard, at least one more sample by the original analyst is chosen to resort. If this also exceeds the standard, the contractor is notified and must resort all samples originally sorted by that person.

Biomass Determinations

For those samples where it is required, biomass is measured as wet weight for each of six major taxonomic groups: annelids, arthropods, mollusks, ophiuroids, other echinoderms, and all other phyla combined. After sorting into groups, the preserved samples are poured through a funnel onto a small nylon mesh screen and subjected to suction filtration for approximately 10 seconds. This process ensures standard moisture content in each sample. Samples are then immediately transferred to an Ohaus CT200-S balance and weighed to the nearest hundredth of a gram. All laboratory balances are serviced and calibrated twice a year. Separate weights are obtained for extremely large individual specimens so that they can be correlated with the benthic data. The biomass data are reviewed prior to being entered into an Oracle database.

Reidentifications

Marine organisms from the benthic grab samples are identified to species or the lowest taxon possible by staff marine biologists. Worksheets are employed to ensure uniformity in recording of benthic data. At least 10% of the samples analyzed per survey are reidentified by the Taxonomy Group specialists. These samples are chosen from each biologist's completed samples by the Taxonomy Group supervisor. Each biologist has at least one sample reidentified as a check on the accuracy and consistency of each analyst every other survey.

For each sample that is reidentified, the Taxonomy Group supervisor records the original identifications on the worksheet and circles the differences which warrant closer inspection. The analyst who did the reidentification goes back through the sample and pulls out the animals in question. The correct identification is then established, in conjunction with the original taxonomist. Notes of this check are made on the reidentification worksheet. These notes should be clear to a third party examining the sheet, for example: "Accidentally recorded on the wrong line," or "Incorrectly identified by the original identifier." These quality control procedures often may define different opinions on taxonomic problems.

Data Review

After all of the benthic samples have been identified, a comprehensive review of the data is done by the Taxonomy Group Supervisor. The benthic field sheets are reviewed and compared to the infauna data reported and anomalies noted for the subsequent community analyses. For example, if the biomass of missorted organisms

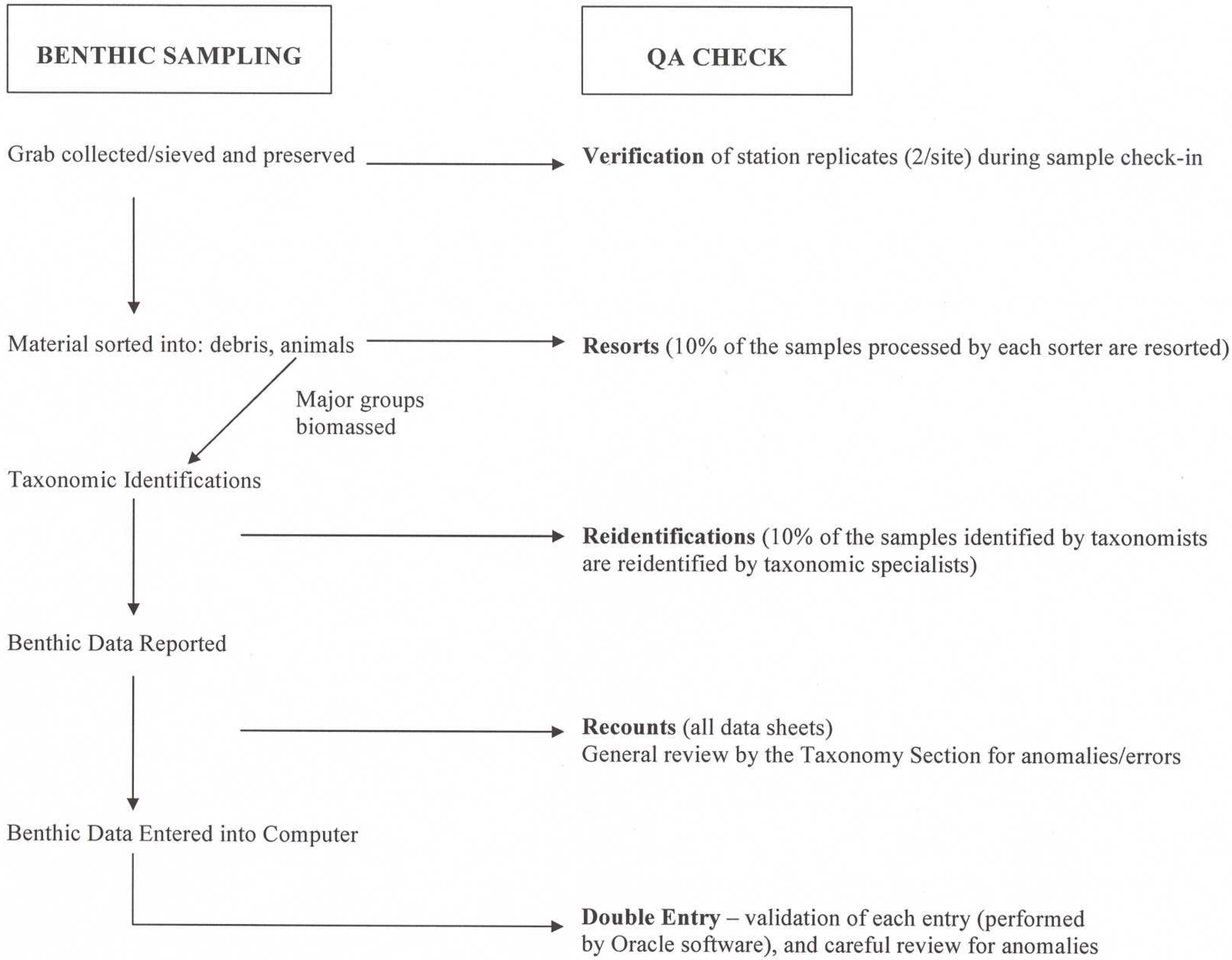


Figure 3
Flow diagram representing the QA steps in benthic macrofaunal sample analysis.

corrections are made as appropriate. Data obtained from the resorts and reidentifications are also added to the corresponding benthic data sheets. Finally, the identifications recorded at each station are reviewed for errors and/or anomalies, which may require further review of the original identification or enumerations.

Fish Tissue Burden Analyses

Three composite samples per station are taken from at least three individuals for each target species sampled from each station. These composite muscle or liver samples are analyzed for tissue burden levels of priority pollutants, trace metals, chlorinated pesticides and PCBs, and volatile and semi-volatile organic compounds using EPA methods by the City of San Diego Wastewater Chemistry Laboratory.

Preparation

In order to avoid sample contamination, all dissection tools and Teflon sheets are cleaned with a residue-free detergent (i.e., Alconox) and water, then rinsed with deionized water and acetone and placed into the cleaning beaker. The scalpels are positioned blade holder down, forceps are pointed down and scissors are oriented blade down. Under the hood, the beaker is filled halfway with acetone and placed in a sonicator for 20 minutes. At the end of this period, the acetone is decanted off, the beaker is refilled, and the sonication step is repeated. The Teflon dissection pads are washed with residue-free detergent and water and rinsed with deionized water, 10% nitric acid and acetone. They are then allowed to dry under the hood. A dissection station, consisting of a Teflon pad, three scalpels (one for skin, one for muscle and one for liver), three forceps (one for each tissue type), one pair of scissors and two cleaned Teflon sheets inside glass petri dishes (one for liver and one for muscle), is set up on a clean laboratory table. Dissection jars are tare weighed and labeled. All records (Sample Weight Record Sheet, Sample Log/Chain of Custody and Fish Description Form) are kept up to date and checked at the end of the day.

Dissection

The fish are sorted by species and thawed in foil on clean trays. Each fish included in the sample is weighed, measured, sexed (if possible) and any parasites or tumors are noted on the Fish Description Form. Each fish is dried with a paper towel and placed into the center of the Teflon pad. Using a scalpel designated for skin use, an incision is made around the muscular section of the fish's body (avoiding the head, gut, fin, and tail areas). The point of the blade is inserted just beneath the skin. The skin is then removed using the skin forceps. It is important to ensure that the forceps do not touch any exposed muscle tissue. Once the skin is removed, a second incision is made inside of the first incision in the exposed muscle region using the muscle scalpel. This scalpel is used exclusively for the removal of muscle tissue. The muscle is cut to the bone and care is taken that the second incision does not cross the first. The muscle scalpel and forceps are used to remove the muscle tissue and place it onto the muscle Teflon sheet. After all the muscle tissue has been removed it is then placed into a chilled sample jar. The jar is examined to be sure all contaminants (i.e. scales, blood, etc.), are removed. It is then weighed to determine the sample weight.

Liver is removed by laying the fish on its side and opening up the body cavity with the dissecting scissors. The liver scalpel and forceps are used to cut the connective tissue away from the liver. Caution is taken not to cut or puncture the liver, gall bladder, or gut, which will cause sample contamination. When the liver has been freed from surrounding tissue, it is removed from the body cavity and placed on a cleaned Teflon sheet. It is then placed into a sample jar, which has also been kept chilled. The jar is then weighed and liver weight is calculated and entered onto the Fish Description Form.

All instruments and Teflon surfaces are rinsed with deionized water after each dissection and scalpel blades are changed prior to starting a new replicate. New scalpel blades and new cleaned Teflon sheets are used when starting a new station.

When the appropriate amount of tissue has been obtained for each sample replicate, the final weights are recorded on the Sample Weight Record Sheet, the Sample Log is completed, and the sample jars are placed into the freezer for storage. The samples are kept frozen until analysis. All final information on total sample weights, species, log number and station/date data are transferred to the chain of custody form which accompanies the frozen samples to the City of San Diego Wastewater Chemistry Laboratory for final analysis.

Bioassay Laboratory Standard Operation Procedures

The Bioassay Laboratory conducts aquatic toxicity testing of effluent, influent, groundwater, and receiving water samples as required by the City's NPDES permits. The laboratory received its initial certification from the State of California Department of Health Services, Environmental Laboratory Accreditation Program (ELAP) on April 22, 1994, and officially commenced operation on this date. The bioassay laboratory's ELAP certification has since been renewed on a bi-annual basis, and the current certification is scheduled for renewal on April 30, 2004 (**Table 3**).

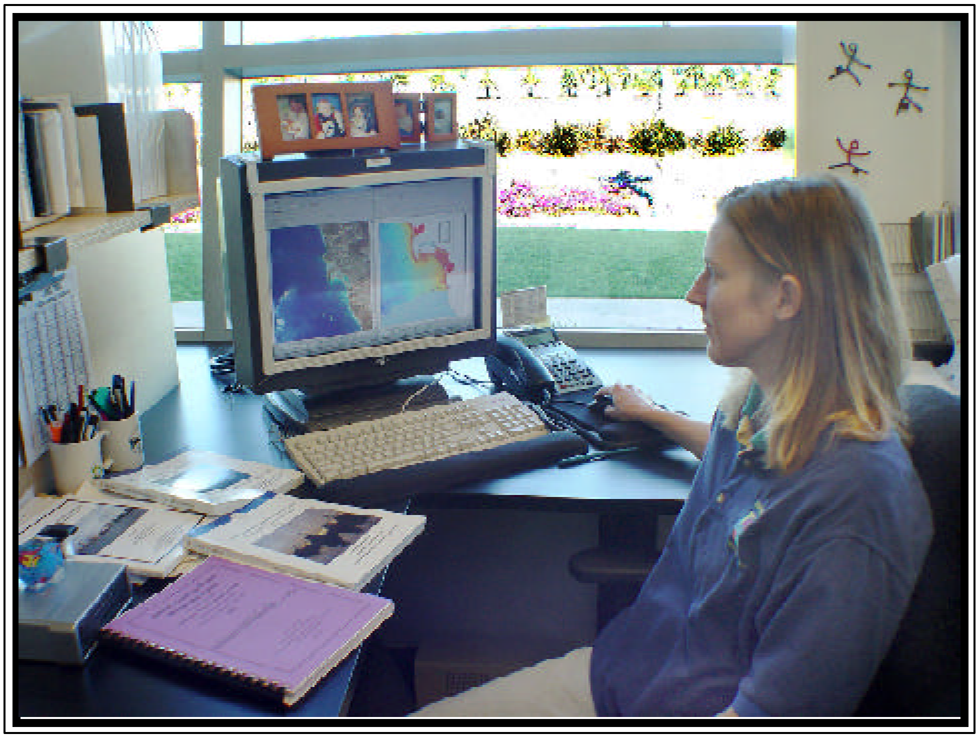
In addition to inspections and documentations of laboratory quality assurance activities, the ELAP certification requires the toxicology staff to continually demonstrate competency in conducting bioassays using standardized methods and to participate in the annual Discharge Monitoring Report-Quality Assurance (DMR-QA) exercise administered by the U.S. EPA. The results of these studies are used by the U.S. EPA to assess laboratory performance. The DMR-QA results from City's bioassay laboratory have been deemed acceptable for all years of participation.

The City's toxicologists actively participate in the Southern California Toxicity Assessment Group (SCTAG). SCTAG includes representatives from federal and state regulatory agencies, municipal and industrial dischargers, consulting laboratories, and academia that are involved with the biological assessment of effluent and water quality. The objectives of SCTAG are to facilitate the use of new and appropriate test procedures, to stimulate communication and interaction between the various groups tasked with regulating and assessing the biological impacts of discharges, and to provide input to regulators on policy issues.

The Bioassay Laboratory's Quality Assurance Manual (QAM) provides a detailed description of the standard operating procedures (SOPs) used for conducting toxicity testing of effluents, influents, groundwater, and receiving waters (see City of San Diego, 2001). The SOPs include all aspects of toxicity testing that can potentially affect data quality and interpretation of results. These include the sampling and handling of influents, effluents, groundwater, and receiving waters; the condition and source of organisms used in the bioassays; equipment used to perform the tests; calibration of test instruments; the use of reference toxicants; recordkeeping; laboratory safety, and the statistical evaluation and interpretation of data.

The City's Bioassay Laboratory quality assurance program includes timely and accurate record keeping. Records of inspections, control charts, and procedures provide proof of performance and serve as a reference to guide future activities. The QAM describes the types of records maintained in the bioassay laboratory for all components of daily operation.

Data Management



Dawn Olson, Information Systems Analyst III

The flow of data from analysis to the final report is controlled to ensure that data is of the highest quality. The general flow of data is represented in **Figure 4**.

Data Review Procedures

Prior to database population, all digital and hardcopy field data sheets are subjected to several rounds of quality control inspections for accuracy and completeness of the information. To avoid errors that are impossible to correct after the fact, technicians, biologists, and marine biologists collecting field data review the recorded station occupation and visual observation information for accuracy and completeness prior to leaving a station. Errors or omissions are corrected immediately. The field sheets are then returned to the laboratory for review by the appropriate supervisor. The supervisor reviews the field sheets, questions problematic records, corrects the sheets as needed, and initials and dates each page. Marine Biologists from the DM&R group review the information on the field data sheets for completeness and accuracy one final time prior to data entry by members of the IT/GIS Systems work group.

All lab data sheets also undergo appropriate review prior to data entry. When microbiological data is reviewed by the Microbiology supervisor, calculations of bacterial density are checked and the data sheet is initialed. The data sheet is then submitted to the IT/GIS Systems work group for entry into the database. Benthic infaunal data sheets are checked by the supervisor of the Taxonomy Group. This review process identifies and corrects any anomalous data such as species record, species abundance, or recording errors. The taxonomy supervisor must also resolve any issues resulting from the careful inspection of the re-identification data.

Data Entry Procedures

Data from the ocean monitoring program is stored in an Oracle database and each data type is subjected to a unique protocol of rigorous data validation. Water quality, infaunal, and trawl community data are managed in-house, while sediment particle size, chemistry, and tissue burden data are maintained by the Wastewater Chemistry (WWC) Laboratory. Chemistry data are retrieved from the WWC Oracle database for analysis and reporting by the Marine Biology and Ocean Operations Laboratory. The imported data are checked to validate individual fields and to verify that the data set is complete before any data analysis is performed.

Bacteriological and visual observation data are entered once and manually checked for data input and reporting errors. Using a hard copy printout of the database contents, each data entry error is red-lined, the error is recorded in a data correction log, the printout initialed and dated by the data reviewer, and is then returned to the Word Processing Operator for correction.

CTD data are collected electronically in the field. Raw data files are archived, while a subset of the raw data is loaded into the Oracle database via an automated routine. This load program extracts data from the raw CTD file at appropriate, discrete depths such that physical parameters of the water column can be correlated with the bacteriological and environmental data collected at those discrete depths.

Field and laboratory records generated

↓

Review in the field or laboratory by staff biologist, marine biologist or laboratory technicians

↓

Review by supervising Marine Biologist/Biologist III

↓

Data entry/collection/transfer

↓

Data entry QA/QC

↓

Data analysis recorded on Data Analysis Tracking Form

↓

Data summaries (i.e., tables & figures) generated

↓

Data summaries QA by second Marine Biologist

↓

Draft report submitted to Working Groups & DM&R Biologist III for QA/QC

↓

Second draft of report generated

↓

Report QA/QC by Senior Marine Biologist/Senior Biologist/Senior Chemist, as appropriate

↓

Final report submitted to regulatory agencies

Figure 4
Flow diagram representing the QA steps in data management from the field to reporting.

Benthic infauna and trawl community data are entered into the Oracle database twice, each time by a different analyst. As the second analyst enters each record, an automated routine compares the first and second entries and requires the analyst to resolve any discrepancy before continuing data entry. This system provides an accurate and complete data set after the second data entry.

Data Analysis and Reporting

Once the data have been validated, they are analyzed and reported to the appropriate regulatory or contract agencies. A system of QA measures has been instituted to ensure that the data are accurately reported. Data analysis processes are documented and archived so that analytical errors may be tracked to their source for correction (**Table 4**). Although the procedures differ somewhat for each data type, the process is intended to identify missing data or outliers and to ensure that all metadata are accounted for during analysis. QA of the resulting data tables and figures occurs before any report drafts are produced. Finally, each report is reviewed by a process that includes biologists, marine biologists, chemists, and supervisors.

Data analyses are performed using several different platforms. Basic statistical analyses, such as descriptive community parameters, are generally computed using command-line SQL, SQL scripts, Excel, or SAS. More complex, multivariate and pattern analyses are performed using the SAS, Ecological Analysis Package (EAP) software (see Smith 1982, Smith et al. 1988), and PRIMER (Plymouth Routines in Multivariate Ecological Research) statistical software applications. Map products representing the distribution of spatial data are prepared in ESRI’s ArcMap software and 3D data modeling is performed using Intergraph Corporation’s Voxel Analyst. Presentation of the data for reports is often accomplished using a combination of word processing, desktop publishing, and other specialized graphics programs (e.g., SigmaPlot) on the PC platform.

Table 4

Data analysis tracking form used in the analysis of receiving waters monitoring data for QA of data, analytical processes, and data tables and figures.

City of San Diego MBOO Laboratory - Data Analysis Tracking Form

Report/Project: ____________________ Year: __________ Analyst: ____________________

Program Library: ____________________ Data Library: ____________________

Draft Report Library: ____________________ Final Report Library: ____________________

Program	Data Set In	Output	Comments/Data Description/Notes	Date	QA/QC In/Date

Results of Quality Assurance Procedures Conducted During 2003

Adriano Feit, Marine Biologist II
Calibrating CTD Unit

RESULTS OF QUALITY ASSURANCE PROCEDURES CONDUCTED DURING CALENDAR YEAR 2003

The results of various quality assurance procedures are presented in the sections that follow. They include: (1) intercalibration of the Conductivity-Temperature-Depth (CTD) instrument used to sample water quality parameters; (2) results of the bacteriological quality assurance procedures; (3) results of the analysis of macrofaunal community sample resorts.

CTD Inter-calibration Exercise

An annual CTD inter-calibration exercise is conducted in order to ensure consistency between the two CTD instruments. Two Sea Bird Electronics model 25 CTD (conductivity, temperature and depth) instruments were used in this inter-calibration exercise. These CTDs are used to collect all of the permit-mandated water quality profiling data. The instrument designated as Unit #3 is a combination CTD/carousel sampler and Unit #4 is a stand-alone CTD.

The exercise involved attaching both CTD units to each other and deploying the package to a depth of 100 meters. After three casts were completed a comparison of six sensor measurements (temperature, salinity, dissolved oxygen, pH, fluorometer and transmissivity) and one calculated parameter (density), was performed to ensure that any observed deviations between the instruments and sensors were within acceptable limits. The results of the three casts are summarized in **Table 5**. The largest difference in transmissivity values (3.85%) was attributed to interference caused by air bubbles generated by the stern of the monitoring vessel. If this value is excluded from consideration, the new single peak transmissivity difference between instruments was 1.88% (Cast 2, 99 meters). Finally, analysis of the raw CTD files indicated that the pressure sensor readings for Unit #4 were generally greater (i.e., indicating increased depth) than those measured by Unit #3. For example, Unit#4 indicated a depth 0.25 meters deeper at the surface and 1.7 meters deeper at a depth of 100 meters. Overall, however, there are no considerable differences between sensor measurements and the instruments and their sensors functioned properly. **Figure 5** depict the results of Cast 2 only and are meant to represent an approximation of what took place during the inter-calibration exercise.

Table 5

Summary of the CTD inter-calibration casts performed during 2003. Data include mean difference, maximum difference, and the cast (i.e., 1, 2, or 3) and depth (m) at which the maximum difference occurred.

Parameter	Mean [a]	Max [a]	Cast	Depth
Temp (C)	0.052	0.615	2	39
Salinity (ppt)	0.011	0.066	3	98
DO (mg/L)	0.198	0.865	1	40
PH	0.023	0.07	1	39
XMS (%)	0.713	1.56	3	2
Density (sigma-t)	0.0099	0.0925	3	39
Fluorometer (µg/L)				
pre-calibration	1.303	1.883	3	4
post-calibration	0.583	1.067	3	2

2003 CTD INTERCALIBRATION CAST

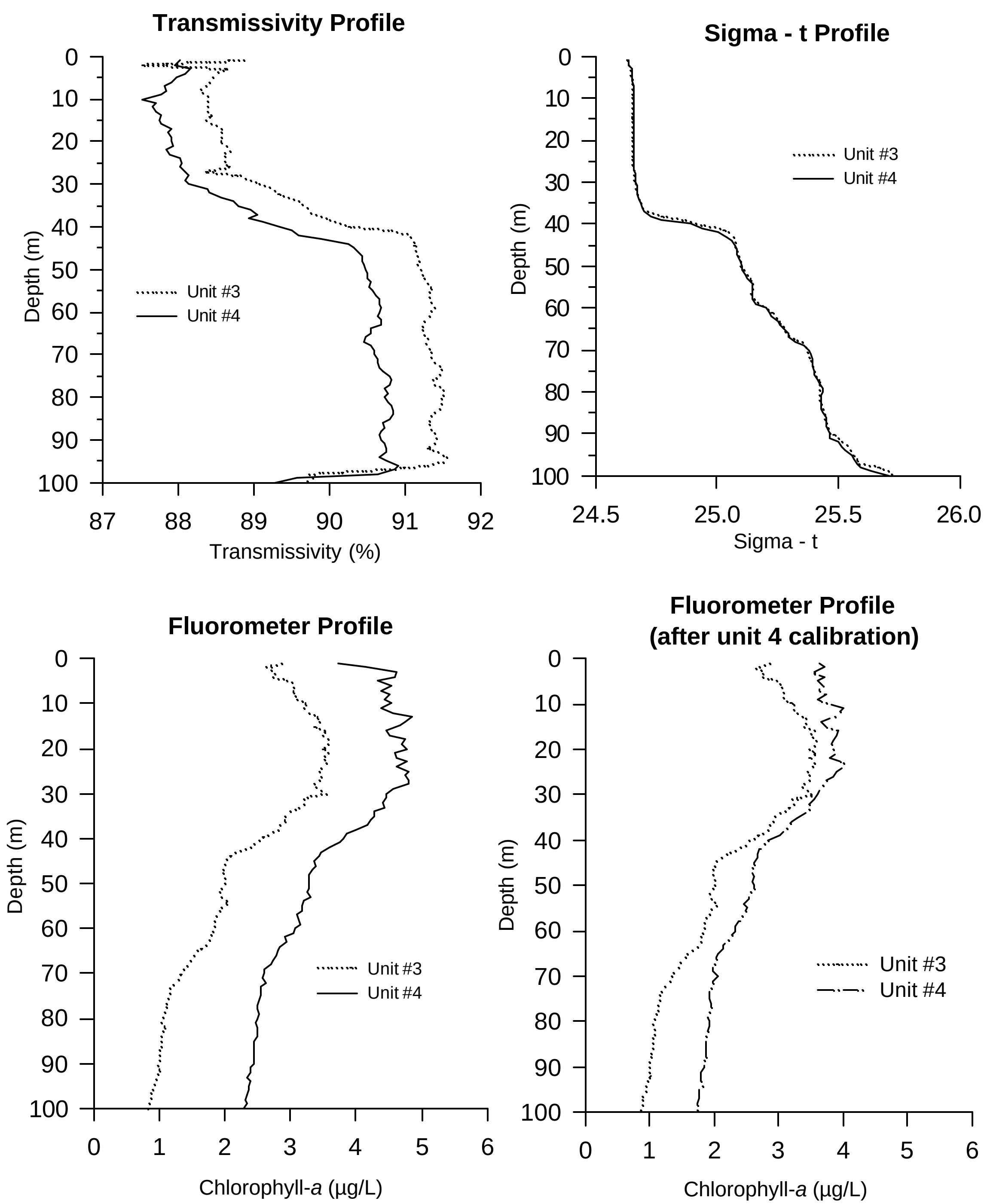


Figure 5

Example results of the 2003 CTD intercalibration casts for CTD units #3 and #4. Data includes cast profiles for transmissivity, density (sigma-t), fluorometry (before and after intercalibration), temperature, salinity, dissolved oxygen and pH.

2003 CTD INTERCALIBRATION CAST

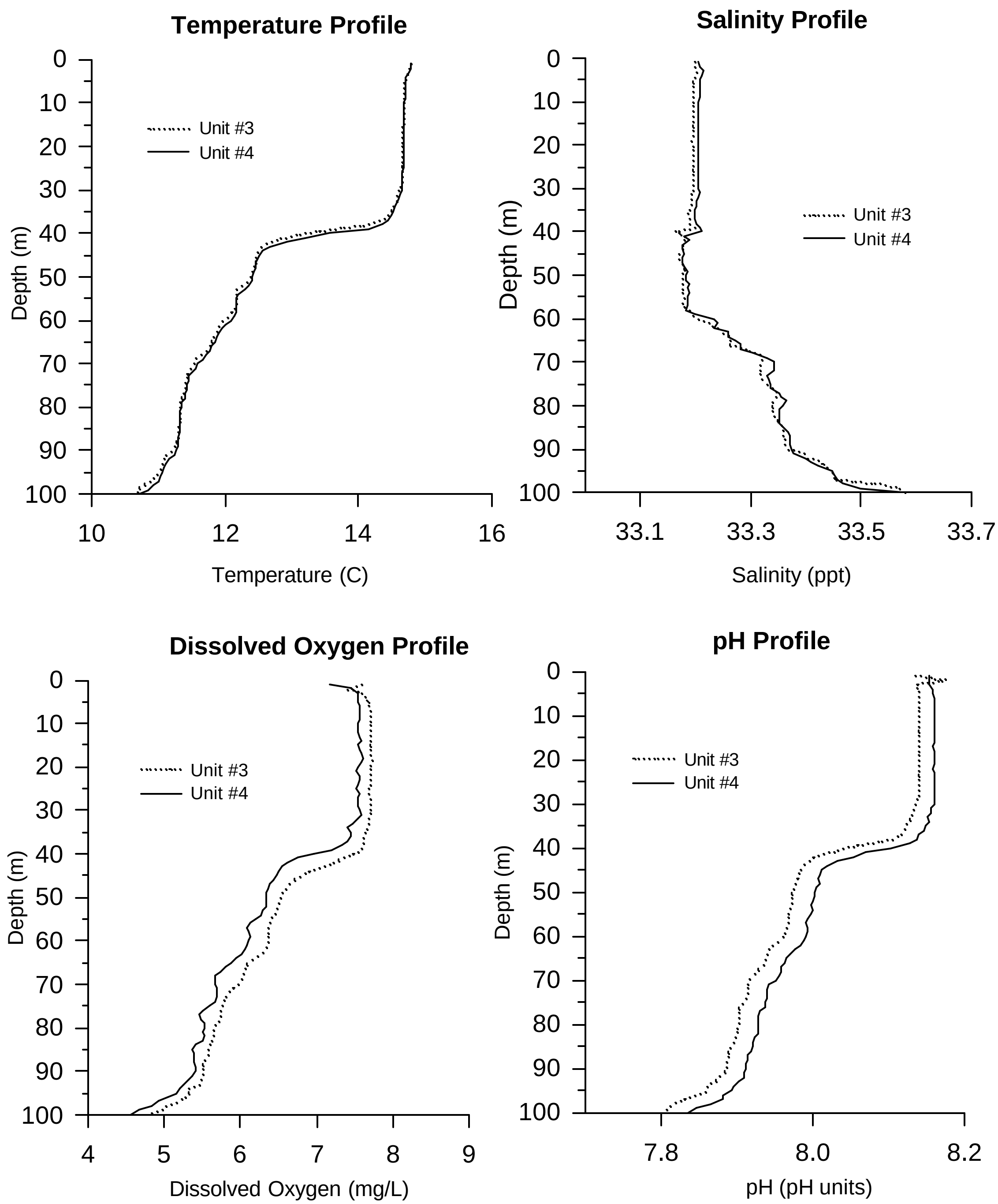


Figure 5 (*continued*)

Bacteriological Quality Assurance Analyses

Duplicate and split bacteriological samples were run as quality assurance checks to measure variability between samples and analyst precision, respectively. A duplicate sample was obtained by taking two distinct samples at a given station in the field and then analyzing them in exactly the same way. A split sample was obtained by taking aliquots of a single field sample and then having two different analysts perform the dilutions, filtration and plating. Both duplicate and split samples were performed on approximately 1% of the offshore monthly water quality samples. The sign test (see Gilbert, 1987: p242) was used to statistically compare the results of the paired duplicate and split samples collected between January and December 2003. The results of this test are summarized in **Table 6**. The raw data for these analyses have been reported previously in Monthly Water Quality Reports for the respective programs (i.e., PLOO, SBOO, and SBWRP).

There were no significant differences between the duplicate or split samples for either total or fecal coliform bacteria, or *Enterococcus* ($p > 0.05$). These results indicate that analytical techniques were similar and intra-sample variation in *Enterococcus* and coliform distribution was not significant.

The laboratory QA officer conducts monthly comparisons of bacterial colony counts to quantify the counting precision of each analyst and the precision counts completed by pairs of analysts. Each analyst must be able to duplicate his/her own prior colony counts within 5% and counts by any two analysts must fall within 10% of each other.

Macrofaunal community Analyses – Resort Analysis

The sorting of benthic samples is contracted to an outside laboratory and resorts are performed as QA for the contract and for the macrofaunal community analyses. The original sorting of a sample fails the QA criteria level

Table 6

Summary of duplicate and split bacteriological anaylses for the Point Loma Ocean Outfall and South Bay Ocean Outfall monitoring programs conducted from January through December 2003. The paired duplicate and split samples were each compared using the sign test (see Gilbert, 1987) at a p=0.05 level of significance.

		N	B	Zb	P	Ho
Duplicate Samples	*Entero*	85	34	-1.84	>0.05	ACCEPT
	Fecal	98	55	1.21	>0.05	ACCEPT
	Total	98	58	1.82	>0.05	ACCEPT
Split Samples	*Entero*	72	32	-0.94	>0.05	ACCEPT
	Fecal	73	41	1.05	>0.05	ACCEPT
	Total	75	42	1.04	>0.05	ACCEPT

H_o = There is no significant difference between the samples being compared
N = number of pairs of data
B = the number of positive differences between pairs
Zb = sign test result

Table 7

Results of benthic resort analyses for the Point Loma Ocean Outfall (E and B stations) and South Bay Ocean Outfall (I stations) monitoring programs conducted during 2003. Percent = (the # of animals found in the resorted sample/the total sample abundance) X 100. ^{1} and ^{2} indicate sample replicate number. * = indicates samples that failed QA/QC check.

Quarter	Station	Percent	Quarter	Station	Percent
Oct-02	E-5^{1}	0.64	*Apr-03*	E-17^{1}	0.00
	B-8^{1}	0.63		E-11^{1}	0.78
	E-25^{1}	0.26		E-15^{2}	0.00
	B-9^{2}	0.35		E-23^{2}	0.41
	E-11^{1}	0.00		E-5^{2}	0.00
	E-8^{1}	0.00		B-8^{1}	2.15
	E-7^{2}	0.00		E-21^{1}	0.92
				E-26^{1}	0.55
Jan-03	E-20^{2}	0.39	*Jul-03*	E-5^{1}	0.00
	B-8^{2}	1.04		E-11^{2}	0.00
	E-7^{2}	1.45		E-26^{1}	0.19
	E-7^{1}	0.75		E-20^{2}	0.00
	E-17^{2}	1.82		I-2^{1}	5.56*
	E-20^{1}	1.09		I-12^{1}	3.16
	I-2^{2}	2.35		I-18^{1}	2.30
	I-14^{2}	0.67		I-22^{2}	53.22*
	I-8^{2}	0.82		I-30^{2}	2.48
	I-4^{1}	0.00		I-21^{2}	1.98
	I-22^{1}	1.59		I-2^{2}	1.52
	I-28^{2}	2.21		I-22^{1}	2.03
	I-1^{2}	7.95*		I-1^{2}	0.00
	I-30^{2}	0.00		I-14^{1}	0.00
	I-3^{2}	0.71		I-16^{2}	0.00
				I-29^{1}	0.00
				I-33^{2}	0.36

if the resort has more than 5% of the total abundance of organisms from that sample. The resort results for the period from October 2002 through December 2003 are shown in **Table 7**. For the October 2002 through April 2003 period, all but one of the 30 samples resorted met the 5% QA level.

In July 2003, the sorting contract was awarded to a new outside laboratory. The South Bay Ocean Outfall (SBOO) samples were the first to be sorted. Originally, six samples were selected for resorting and two of the samples failed the 5% QA level. From the two stations that failed, the alternate rep was resorted and both passed the QA check. In consultation with the contractor, it was determined that their internal QA/QC checks were inadequate for the required sorting efficiency. All samples were returned for complete resorting and new internal QA/QC procedures (20% resort of all samples) were implemented. Resorts of five subsequent SBOO samples and four Point Loma samples all passed the 5% QA/QC level.

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Marine Biology and Ocean Operations Literature Collection

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APPENDICES

Appendix A

ISO 14001 Documentation

An inventory of Marine Biology and Ocean Operations Laboratory and
Marine Microbiology and Vector Management Laboratory
Standard operating procedure (SOP) documents

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MARINE BIOLOGY OCEAN OPERATIONS
A**SOPs**@
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_SOPs** Note: Controlled copies (hard copies) are located in the SOP binder in the MBOO library and with other staff according to the appropriate distribution list.		
Environmental Document Control SOP	MBOO-SOP-001.1-05032002	*Indefinitely*
Competency Training and Evaluation SOP	MBOO-SOP-002.1-05102002	*Indefinitely*
MSDS Control Procedure SOP	MBOO-SOP-003.0-05022002	*Indefinitely*
SOP for Fume Hood Testing	MBOO-SOP-004.1-04262002	*Indefinitely*
OCEAN OPERATIONS		
Boat		
1. Metro SOP	MBOO-SOP-BT001.0-05032002	*Indefinitely*
2. MIII SOP	MBOO-SOP-BT002.0-05062002	*Indefinitely*
Ocean Operations		
1. BenthicSamplingSOP	MBOO-SOP-OC001.0-05062002	*Indefinitely*
2. KelpWQSamplingSOP	MBOO-SOP-OC002.0-05062002	*Indefinitely*
3. MonthlyWQSamplingSOP	MBOO-SOP-OC003.0-05062002	*Indefinitely*
4. TrawlSamplingSOP	MBOO-SOP-OC004.0-05062002	*Indefinitely*
5. CTDSOP	MBOO-SOP-OC005.0-05032002	*Indefinitely*
6. DiveSOP	MBOO-SOP-OC006.0-05062002	*Indefinitely*

FACILITY: MARINE BIOLOGY OCEAN OPERATIONS	
A**SOPs**@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

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THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_SOPs** Note: Controlled copies (hard copies) are located in the SOP binder in the MBOO library and with other staff according to the appropriate distribution list.		
7. Month_QuarterCalSOP	MBOO-SOP-OC007.0-11182002	*Indefinitely*
Tissue Burden		
1. FishTissueSOP	MBOO-SOP-TB001.0-05062002	*Indefinitely*
BIOASSAY LABORATORY		
1. RAbalone-SOP	MBOO-SOP-TX001.0-05082002	*Indefinitely*
2. CeriodaphniaAcute-SOP	MBOO-SOP-TX002.0-05082002	*Indefinitely*
3. AmphiopodSediment-SOP	MBOO-SOP-TX003.0-05082002	*Indefinitely*
4. BivalveDevelopment-SOP	MBOO-SOP-TX004.0-05082002	*Indefinitely*
5. CeriodaphniaCulturing-SOP	MBOO-SOP-TX005.0-05082002	*Indefinitely*
6. ControlChartGeneration-SOP	MBOO-SOP-TX006.0-05082002	*Indefinitely*
7. SanDollarSperm-SOP	MBOO-SOP-TX007.0-05082002	*Indefinitely*
8. FatheadAcute96Juv-SOP	MBOO-SOP-TX008.0-05082002	*Indefinitely*
9. FatheadAcuteLarval-SOP	MBOO-SOP-TX009.1-01272003	*Indefinitely*
10. GiantKelpGermGrowth-SOP	MBOO-SOP-TX010.0-05082002	*Indefinitely*
11. MenidiaChronicLarval-SOP	MBOO-SOP-TX011.0-05082002	*Indefinitely*
12. Microtox-SOP	MBOO-SOP-TX012.0-05082002	*Indefinitely*
13. MysidopsisAcute-SOP	MBOO-SOP-TX013.0-05082002	*Indefinitely*

EMS DOCUMENT INVENTORY

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14. TopsmeltChronicLarval-SOP	MBOO-SOP-TX014.0-05082002	*Indefinitely*
15. TopsmeltAcute96-SOP	MBOO-SOP-TX015.1-01272003	*Indefinitely*
16. TopsmeltAcute48-SOP	MBOO-SOP-TX016.0-05082002	*Indefinitely*
17. UrchinFertilization-SOP	MBOO-SOP-TX017.2-12042003	*Indefinitely*
18. UrchinDevelopment-SOP	MBOO-SOP-TX018.0-05082002	*Indefinitely*
19. AcidBathInsp-SOP	MBOO-SOP-TX019.0-05082002	*Indefinitely*
20. Alkalinity-SOP	MBOO-SOP-TX020.0-05082002	*Indefinitely*
21. Hardness-SOP	MBOO-SOP-TX021.0-05082002	*Indefinitely*
22. AmbientWaterColl-SOP	MBOO-SOP-TX022.0-05082002	*Indefinitely*
23. EquipmentMaintenance-SOP	MBOO-SOP-TX023.0-05082002	*Indefinitely*
24. MeterCalibration-SOP	MBOO-SOP-TX024.0-05082002	*Indefinitely*
25. StockCultures-SOP	MBOO-SOP-TX025.0-05082002	*Indefinitely*
26. Safety-SOP082002	MBOO-SOP-TX026.0-05082002	*Indefinitely*
27. Sampling-SOP	MBOO-SOP-TX027.0-05082002	*Indefinitely*
28. LabwareSanitation-SOP	MBOO-SOP-TX028.0-05082002	*Indefinitely*
29. TRChlorine-SOP	MBOO-SOP-TX029.0-05082002	*Indefinitely*
30. QAQCplan-SOP	MBOO-SOP-TX030.0-05082002	*Indefinitely*
31. QAreport-SOP	MBOO-SOP-TX031.0-05082002	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

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32. PowerFailure-SOP	MBOO-SOP-TX032.0-05082002	*Indefinitely*
33. Autopipets-SOP	MBOO-SOP-TX033.0-05082002	*Indefinitely*
34. SampleHandlingDisp-SOP	MBOO-SOP-TX034.0-05082002	*Indefinitely*
35. DataReduction-SOP	MBOO-SOP-TX035.0-05082002	*Indefinitely*
36. DataRecording-SOP	MBOO-SOP-TX036.0-05082002	*Indefinitely*
37. SampleCustody-SOP	MBOO-SOP-TX037.0-05082002	*Indefinitely*
38. CorrectiveAction-SOP	MBOO-SOP-TX038.0-05082002	*Indefinitely*
39. BalanceCalibration-SOP	MBOO-SOP-TX039.0-05082002	*Indefinitely*
40. IntemalAudit-SOP	MBOO-SOP-TX040.0-05082002	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MARINE MICROBIOLOGY AND VECTOR MANAGEMENT	
A**SOPs**@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\BACTI\SOP**		
Maintenance and Monitoring of Lab Incubators, Waterbaths, and Refrigerators	MMVM-SOP-001.1-04222002	*Indefinitely*
Calibration of Lab Thermometers	MMVM-SOP-002.0-03042002	*Indefinitely*
Laboratory Cleanliness	MMVM-SOP-003.0-03042002	*Indefinitely*
Vitek Verification	MMVM-SOP-004.0-03042002	*Indefinitely*
Membrane Filtration: Total and Fecal Coliforms	MMVM-SOP-005.1-03052003	*Indefinitely*
Membrane Filtration: Enterococcus	MMVM-SOP-006.0-03042002	*Indefinitely*
Heterotrophic Plate Count	MMVM-SOP-007.1-08042002	*Indefinitely*
Multiple Tube Fermentation: Total Coliforms	MMVM-SOP-008.0-03042002	*Indefinitely*
Multiple Tube Fermentation: Fecal Coliforms	MMVM-SOP-009.0-03042002	*Indefinitely*
Multiple Tube Fermentation: Enterococcus	MMVM-SOP-0010.0-03042002	*Indefinitely*
Completed Test for Multiple Tube Fermentation	MMVM-SOP-0011.0-03042002	*Indefinitely*
Colilert-18 (Idexx): *E.coli* and Total Coliforms	MMVM-SOP-0012.3-06162003	*Indefinitely*
Enterolert (Idexx): Enterococcus	MMVM-SOP-0013.0-03042002	*Indefinitely*
Sampling Procedure for NCWRP and SBWRP	MMVM-SOP-0014.0-03042002	*Indefinitely*
Coliphage Membrane Filtration Technique	MMVM-SOP-0015.1-06262003	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MARINE MICROBIOLOGY AND VECTOR MANAGEMENT
A**SOPs**@
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\BACTI\SOP**		
Coliphage Top Overlay Agar Method	MMVM -SOP-0016.0-03042002	*Indefinitely*
Enteric Virus: Plaque Assay	MMVM -SOP-0017.0-03042002	*Indefinitely*
Enteric Virus: Cytophathic Effect (CPE)	MMVM -SOP-0018.0-03042002	*Indefinitely*
Virus Adsorption-Elution-Precipitation Procedure	MMVM -SOP-0019.0-03042002	*Indefinitely*
Tissue Culture Procedures	MMVM -SOP-0020.0-03042002	*Indefinitely*
Inhibitory Residues on Glassware and Plasticware	MMVM -SOP-0021.1-06172003	*Indefinitely*
Lab Tech Daily Duties	MMVM -SOP-0022.1-06172003	*Indefinitely*
Assistant Lab Tech Daily Duties	MMVM -SOP-0023.1-06162003	*Indefinitely*
Measuring Steam Flow with a Simple Weight	MMVM -SOP-0024.0-03042002	*Indefinitely*
Shoreline Sampling	MMVM -SOP-0025.0-03042002	*Indefinitely*
Autoclave	MMVM -SOP-0026.0-03062002	*Indefinitely*
Balance	MMVM -SOP-0027.1-05092002	*Indefinitely*
Chlorine Colorimeter	MMVM -SOP-0028.0-03062002	*Indefinitely*
Conductivity Meter	MMVM -SOP-0029.0-03062002	*Indefinitely*
Dissolved Oxygen Meter/Corning	MMVM -SOP-0030.0-03062002	*Indefinitely*
Dissolved Oxygen Meter/Orion	MMVM -SOP-0031.0-03062002	*Indefinitely*
Fluorometer	MMVM -SOP-0032.0-03062002	*Indefinitely*
Glass and Plastic Labware: Cleaning and Sterilizing	MMVM -SOP-0033.0-03062002	*Indefinitely*
Glassware Washer	MMVM -SOP-0034.1-06172003	*Indefinitely*
Milli-Q Laboratory Water Purification System	MMVM -SOP-0035.1 -06172003	*Indefinitely*

FACILITY: MARINE MICROBIOLOGY AND VECTOR MANAGEMENT	
A**SOPs**@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\BACTI\SOP**		
pH Meter	MMVM-SOP-0036.2-06272003	*Indefinitely*
Wheaton Unispense Media Dispenser	MMVM-SOP-0037.0-03062002	*Indefinitely*
Media Dispensing Syringe	MMVM-SOP-0038.0-03062002	*Indefinitely*
mENDO Agar LES	MMVM-SOP-0039.1-06172003	*Indefinitely*
mFC Agar	MMVM-SOP-0040.1-06172003	*Indefinitely*
Plate Count Agar	MMVM-SOP-0041.0-03062002	*Indefinitely*
BEA Agar	MMVM-SOP-0042.0-03062002	*Indefinitely*
Trypticase Soy Agar	MMVM-SOP-0043.0-03062002	*Indefinitely*
mEI Agar	MMVM-SOP-0044.1-06272003	*Indefinitely*
Brain Heart Infusion Broth & Agar	MMVM-SOP-0045.0-03062002	*Indefinitely*
Lauryl Tryptose Broth	MMVM-SOP-0046.0-03062002	*Indefinitely*
Brilliant Green Bile Broth	MMVM-SOP-0047.0-03062002	*Indefinitely*
EC Medium	MMVM-SOP-0048.0-03062002	*Indefinitely*
Phosphate Saline Buffered Water (for mEI)	MMVM-SOP-0049.1-06262003	*Indefinitely*
Phosphate Buffered Dilution Water	MMVM-SOP-0050.0-03082002	*Indefinitely*
Nutrient Agar	MMVM-SOP-0051.0-03082002	*Indefinitely*
Nutrient Broth	MMVM-SOP-0052.0-03082002	*Indefinitely*
Sterilization of Wooden Applicator Sticks	MMVM-SOP-0053.1-06162003	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY:	MARINE MICROBIOLOGY AND VECTOR MANAGEMENT
	A**SOPs**@
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\BACTI\SOP**		
Azide Dextrose Broth	MMVM -SOP-0054.0-03082002	*Indefinitely*
Sampling Procedure for Storm Drains	MMVM -SOP-0055.0-03082002	*Indefinitely*
Ascaris Ova Procedure	MMVM -SOP-0056.0-03082002	*Indefinitely*
Recycle	MMVM -SOP-0057.0-03112002	*Indefinitely*
Chain of Custody	MMVM -SOP-0058.0-03112002	*Indefinitely*
Avon Boat	MMVM -SOP-0059.1-06162003	*Indefinitely*
Salmonella	MMVM -SOP-0060.0-03112002	*Indefinitely*
Preparation of Bacterial Slants for QC	MMVM -SOP-0061.0-03112002	*Indefinitely*
Competency Training and Evaluation	MMVM -SOP-0062.1-04292002	*Indefinitely*
Midge Prevention and Control Program	MMVM -SOP-0063.0-03142002	*Indefinitely*
Vector Control	MMVM -SOP-0064.0-03142002	*Indefinitely*
ISO Document Control	MMVM -SOP-0065.0-04172002	*Indefinitely*
Battery Recycling	MMVM -SOP-0066.0-04242002	*Indefinitely*
Non-Regulated Water Quality Bacti Triggers	MMVM -SOP-0067.0-04242002	*Indefinitely*
Sewage Spill	MMVM -SOP-0068.0-04252002	*Indefinitely*
Incident Communication Log	MMVM -SOP-0069.0-04252002	*Indefinitely*
Biohazardous Waste Disposal	MMVM -SOP-0070.0-04302002	*Indefinitely*
Use and Management of SOPs	MMVM -SOP-0071.0-05012002	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY:	MARINE MICROBIOLOGY AND VECTOR MANAGEMENT
	A**SOPs**@
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\BACTI\SOP**		
AB411 Regulated Bacti Overlimits	MMVM -SOP-0072.0-05022002	*Indefinitely*
Spill Kits	MMVM -SOP-0073.0-05072002	*Indefinitely*
SPWRP Hazardous Waste Disposal	MMVM -SOP-0074.0-05132002	*Indefinitely*
Ocean Vessel Supply and Sample Transport	MMVM -SOP-0075.1-06262003	*Indefinitely*
Miscellaneous Reagents	MMVM -SOP-0076.0-02032003	*Indefinitely*
Hot Air Oven	MMVM -SOP-0077.0-05072003	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MBOO - Toxicity	
AForms: Toxicity@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISODOCs\MBOO_Forms\Toxicity**		
TopsmeltPLE96mort	MBOO-F-TX001.0-0502	*Indefinitely*
TopsmeltPLE96wq	MBOO-F-TX002.0-0502	*Indefinitely*
TopsmeltPLE48mort	MBOO-F-TX003.0-0502	*Indefinitely*
TopsmeltPLE48wq	MBOO-F-TX004.0-0502	*Indefinitely*
RAbaloneAcclim	MBOO-F-TX005.0-0502	*Indefinitely*
RAbalonePLEct	MBOO-F-TX006.0-0502	*Indefinitely*
RAbaloneRTct	MBOO-F-TX007.0-0502	*Indefinitely*
Acclimation	MBOO-F-TX008.2-0303	*Indefinitely*
Amphipod9Dobsv	MBOO-F-TX009.0-0502	*Indefinitely*
Amphipod9Dmort	MBOO-F-TX010.0-0502	*Indefinitely*
AmphipodDwq	MBOO-F-TX011.0-0502	*Indefinitely*
BalanceCalibration	MBOO-F-TX012.0-0502	*Indefinitely*
SampleChainCustody	MBOO-F-TX013.0-0502	*Indefinitely*
Ceriodaphnia96mort	MBOO-F-TX014.0-0502	*Indefinitely*
Ceriodaphnia96wq	MBOO-F-TX015.0-0502	*Indefinitely*
RAbaloneSpawn	MBOO-F-TX016.0-0502	*Indefinitely*
CeriodaphniaTJ48mort	MBOO-F-TX017.0-0502	*Indefinitely*
CeriodaphniaPLE48mort	MBOO-F-TX018.0-0502	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MBOO - Toxicity	
AForms: Toxicity@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISODOCs\MBOO_Forms\Toxicity**		
CeriodaphniaTJ48wq	MBOO-F-TX019.0-0502	*Indefinitely*
CeriodaphniaDMRQA48wq	MBOO-F-TX020.0-0502	*Indefinitely*
CeriodaphniaPLE48wq	MBOO-F-TX021.0-0502	*Indefinitely*
Ceriodaphnia7Dmort	MBOO-F-TX022.0-0502	*Indefinitely*
Ceriodaphnia7Dwq	MBOO-F-TX023.0-0502	*Indefinitely*
DilutionWaterPrepRecord	MBOO-F-TX024.0-0502	*Indefinitely*
CalibLogDOysi	MBOO-F-TX025.0-0502	*Indefinitely*
FHMjuvPLE96mortwq	MBOO-F-TX026.0-0502	*Indefinitely*
FHMlarv96renwlmort	MBOO-F-TX027.0-0502	*Indefinitely*
FHMlarv96renwlwq	MBOO-F-TX028.0-0502	*Indefinitely*
FHMlarvDMRQA48wq	MBOO-F-TX029.0-0502	*Indefinitely*
LabNotesBlnk	MBOO-F-TX030.0-0502	*Indefinitely*
Microtox	MBOO-F-TX031.0-0502	*Indefinitely*
MysidopsisPLE48mort	MBOO-F-TX032.0-0502	*Indefinitely*
MysidopsisPLE48wq	MBOO-F-TX033.0-0502	*Indefinitely*
ReportRoute	MBOO-F-TX034.1-0903	*Indefinitely*
SamplingRecord	MBOO-F-TX035.0-0502	*Indefinitely*
AbaloneTankwq	MBOO-F-TX036.0-0502	*Indefinitely*
BioassayLog	MBOO-F-TX037.0-0502	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MBOO - Toxicity	
AForms: Toxicity@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISODOCs\MBOO_Forms\Toxicity**		
TopsmeltPLE7d	MBOO-F-TX038.0-0502	*Indefinitely*
AbalonePLEwq	MBOO-F-TX039.0-0502	*Indefinitely*
CeriodaphniaHarvestRecord	MBOO-F-TX040.0-0502	*Indefinitely*
GiantKelpPLE	MBOO-F-TX041.2-1202	*Indefinitely*
EnvChmbrCalibrationLog	MBOO-F-TX042.1-1202	*Indefinitely*
Mysidopsis96wq	MBOO-F-TX043.0-0502	*Indefinitely*
Mysidopsis96mort	MBOO-F-TX044.0-0502	*Indefinitely*
TopsmeltSBWRP7d	MBOO-F-TX045.0-0502	*Indefinitely*
RAbaloneSBWRPct	MBOO-F-TX046.0-0502	*Indefinitely*
RabaloneSBWRPwq	MBOO-F-TX047.0-0502	*Indefinitely*
GiantKelpSBWRP	MBOO-F-TX048.3-1202	*Indefinitely*
AcidBathLog	MBOO-F-TX049.0-0502	*Indefinitely*
AcidBathNtrlzLog	MBOO-F-TX050.0-0502	*Indefinitely*
SampleLogin	MBOO-F-TX051.0-0502	*Indefinitely*
CalibLogpHorion	MBOO-F-TX052.0-0502	*Indefinitely*
CalibLogCondysi	MBOO-F-TX053.0-0502	*Indefinitely*
CalibLogRefract	MBOO-F-TX054.0-0502	*Indefinitely*
AnimalLogin	MBOO-F-TX055.0-0502	*Indefinitely*
CalibLogThermtr	MBOO-F-TX056.0-0502	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MBOO - Toxicity	
AForms: Toxicity@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISODOCs\MBOO_Forms\Toxicity**		
CalibLogAmmonia	MBOO-F-TX057.0-0502	*Indefinitely*
TopSmeltPumpStn7d	MBOO-F-TX058.0-1102	*Indefinitely*
RAbalonePumpStnwq	MBOO-F-TX059.0-1102	*Indefinitely*
RAbalonePumpStnct	MBOO-F-TX060.0-1102	*Indefinitely*
GiantKelpPumpStn	MBOO-F-TX061.0-1102	*Indefinitely*
TopsmeltSB96mort	MBOO-F-TX062.0-1202	*Indefinitely*
TopsmeltSB96wq	MBOO-F-TX063.0-1202	*Indefinitely*
MysidSB96mort	MBOO-F-TX064.0-1202	*Indefinitely*
MysidSB96wq	MBOO-F-TX065.0-1202	*Indefinitely*
UrchinFert	MBOO-F-TX066.0-0630	*Indefinitely*

EMS DOCUMENT INVENTORY
ENVIRONMENTAL RECORDS

FACILITY: MBOO	
ΑForms: Field Data Sheets@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_Forms\Field Data Sheets**		
BENTHICS		
1. Benthic Field Data	MBOO-F-BN001.2-0204	*Indefinitely*
2. Infauna Sheets	MBOO-F-BN002.1-0602	*Indefinitely*
3. GrabCheckInChangeLog	MBOO-F-BN003.2-1002	*Indefinitely*
4. Infauna Data Sheet DEEP 2001	MBOO-F-BN004.0-1002	*Indefinitely*
5. Infauna Data Sheet Shallow 2001	MBOO-F-BN005.0-1002	*Indefinitely*
BIOASSAY		
1. Dilution water collection B8	MBOO-F-TX001.2-1102	*Indefinitely*
OTTER TRAWLS		
1. Invertsheet	MBOO-F-TR001.2-1202	*Indefinitely*
2. Otter trawls field data	MBOO-F-TR002.1-0403	*Indefinitely*
3. Trawl field record	MBOO-F-TR003.0-0402	*Indefinitely*
SCUBA DIVING		
1. Divelog	MBOO-F-SC001.1-1102	*Indefinitely*

FACILITY: MBOO	
ΑForms: Field Data Sheets@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_Forms\Field Data Sheets**		
Dive Medical		
1. Diving Medical Exam Overview	MBOO-F-SC072.0-0503	*Indefinitely*
2. Diving Medical History Form	MBOO-F-SC073.0-0503	*Indefinitely*
3. Medical Evaluation of Fitness	MBOO-F-SC074.1-1103	*Indefinitely*
TISSUE BURDEN		
A. Chain of Custody		
1. TBCOC.xls	MBOO-F-TB001.1-0602	*Indefinitely*
B. Fish Tissue		
1. Fish Tissue Analysis_Sample Wt. Record	MBOO-F-TB002.0-1102	*Indefinitely*
2. Regional Tissue Sample Control Sheet	MBOO-F-TB003.0-1102	*Indefinitely*
3. Fish Description Form	MBOO-F-TB004.0-1102	*Indefinitely*
4. Tissue Sample Log	MBOO-F-TB005.0-1102	*Indefinitely*
5. Liver Tissue Tally Sheet	MBOO-F-TB006.1-0403	*Indefinitely*
C. Rig Fishing		
1. Rig Fishing Data Sheet	MBOO-F-TB007.0-1102	*Indefinitely*
WATER QUALITY		
A. Chain of Custody		

FACILITY: MBOO	
AForms: Field Data Sheets@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_Forms\Field Data Sheets**		
1. Bacticustody	MBOO-F-WQ001.0-0402	*Indefinitely*
B. CTD Calibration		
1. Calibrationsheet	MBOO-F-WQ068.1-1102	*Indefinitely*
2. Fluorometer Calibration	MBOO-F-WQ069.0-1102	*Indefinitely*
3. Transmissometer Calibration	MBOO-F-WQ070.0-1102	*Indefinitely*
4. pH Calibration Sheet	MBOO-F-WQ071.0-0303	*Indefinitely*
C. Kelp weekly		
1. BW-ptloma-klp	MBOO-F-WQ002.3-0903	*Indefinitely*
2. ITP-kelp	MBOO-F-WQ003.1-0602	*Indefinitely*
3. MID-outfall klp	MBOO-F-WQ004.1-0602	*Indefinitely*
D. Monthly		
a. NPDES Monthly		
(a) CTD only		
1. New-CTD-only	MBOO-F-WQ005.1-0602	*Indefinitely*
(b) kelpmonthly		
1. Mon-obs-a1	MBOO-F-WQ006.2-0702	*Indefinitely*
2. Mon-obs-a6	MBOO-F-WQ007.2-0702	*Indefinitely*
3. Mon-obs-a7	MBOO-F-WQ008.2-0702	*Indefinitely*
4. Mon-obs-c4	MBOO-F-WQ009.1-0602	*Indefinitely*

FACILITY: MBOO	
ΑForms: Field Data Sheets@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_Forms\Field Data Sheets**		
5. Mon-obs-c5	MBOO-F-WQ-010.1-0602	*Indefinitely*
6. Mon-obs-c6	MBOO-F-WQ011.1-0602	*Indefinitely*
7. Mon-obs-c7	MBOO-F-WQ012.1-0602	*Indefinitely*
8. Mon-obs-c8	MBOO-F-WQ013.1-0602	*Indefinitely*
(c) North&Inshore		
1. Mon-obs-a10	MBOO-F-WQ014.1-0602	*Indefinitely*
2. Mon-obs-a12	MBOO-F-WQ015.1-0602	*Indefinitely*
3. Mon-obs-a14	MBOO-F-WQ016.1-0602	*Indefinitely*
4. Mon-obs-a2	MBOO-F-WQ017.2-0702	*Indefinitely*
5. Mon-obs-a5	MBOO-F-WQ018.2-0702	*Indefinitely*
6. Mon-obs-b12	MBOO-F-WQ019.2-0702	*Indefinitely*
7. Mon-obs-b2	MBOO-F-WQ020.1-0602	*Indefinitely*
8. Mon-obs-b3	MBOO-F-WQ021.2-0702	*Indefinitely*
9. Mon-obs-b5	MBOO-F-WQ022.2-0702	*Indefinitely*
10. Mon-obs-b9	MBOO-F-WQ023.2-0702	*Indefinitely*
(d) Offshore		
1. Mon-obs-b1	MBOO-F-WQ024.2-0702	*Indefinitely*
2. Mon-obs-e10	MBOO-F-WQ025.2-0702	*Indefinitely*
3. Mon-obs-e12	MBOO-F-WQ026.2-0702	*Indefinitely*

FACILITY: MBOO
AForms: Field Data Sheets@
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_Forms\Field Data Sheets**		
4. Mon-obs-e14	MBOO-F-WQ027.2-0702	*Indefinitely*
5. Mon-obs-e16	MBOO-F-WQ028.2-0702	*Indefinitely*
6. Mon-obs-e18	MBOO-F-WQ029.2-0702	*Indefinitely*
7. Mon-obs-e2	MBOO-F-WQ030.2-0702	*Indefinitely*
8. Mon-obs-e5	MBOO-F-WQ031.2-0702	*Indefinitely*
9. Mon-obs-e8	MBOO-F-WQ032.2-0702	*Indefinitely*
b. SBOO Monthly		
(a) North		
1. Mon-obs-i30	MBOO-F-WQ033.1-0602	*Indefinitely*
2. Mon-obs-i32	MBOO-F-WQ034.1-0602	*Indefinitely*
3. Mon-obs-i33	MBOO-F-WQ035.1-0602	*Indefinitely*
4. Mon-obs-i36	MBOO-F-WQ036.1-0602	*Indefinitely*
5. Mon-obs-i37	MBOO-F-WQ037.1-0602	*Indefinitely*
6. Mon-obs-i38	MBOO-F-WQ038.1-0602	*Indefinitely*
7. northctd	MBOO-F-WQ039.1-0602	*Indefinitely*
(b) Outfall		
1. Mon-obs-i14	MBOO-F-WQ040.1-0602	*Indefinitely*
2. Mon-obs-i10	MBOO-F-WQ041.1-0602	*Indefinitely*
3. Mon-obs-i11	MBOO-F-WQ042.1-0602	*Indefinitely*

FACILITY: MBOO	
ΑForms: Field Data Sheets@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_Forms\Field Data Sheets**		
4. Mon-obs-i12	MBOO-F-WQ043.1-0602	*Indefinitely*
5. Mon-obs-i16	MBOO-F-WQ044.1-0602	*Indefinitely*
6. Mon-obs-i18	MBOO-F-WQ045.1-0602	*Indefinitely*
7. Mon-obs-i19	MBOO-F-WQ046.1-0602	*Indefinitely*
8. Mon-obs-i22	MBOO-F-WQ047.1-0602	*Indefinitely*
9. Mon-obs-i23	MBOO-F-WQ048.1-0602	*Indefinitely*
10. Mon-obs-i24	MBOO-F-WQ049.1-0602	*Indefinitely*
11. Mon-obs-i25	MBOO-F-WQ050.1-0602	*Indefinitely*
12. Mon-obs-i26	MBOO-F-WQ051.1-0602	*Indefinitely*
13. Mon-obs-i39	MBOO-F-WQ052.1-0602	*Indefinitely*
14. Mon-obs-i40	MBOO-F-WQ053.1-0602	*Indefinitely*
15. Mon-obs-i9	MBOO-F-WQ054.1-0602	*Indefinitely*
16. outfallctd	MBOO-F-WQ-055.1-0602	*Indefinitely*
(c) South		
1. Mon-obs-i13	MBOO-F-WQ056.1-0602	*Indefinitely*
2. Mon-obs-i20	MBOO-F-WQ057.1-0602	*Indefinitely*
3. Mon-obs-i21	MBOO-F-WQ058.1-0602	*Indefinitely*
4. Mon-obs-i3	MBOO-F-WQ059.1-0602	*Indefinitely*
5. Mon-obs-i5	MBOO-F-WQ060.1-0602	*Indefinitely*

FACILITY: MBOO	
AForms: Field Data Sheets@	
REVIEW FREQUENCY: RECORDS REVIEWED ANNUALLY AND UPDATED AS REQUIRED	

DOCUMENT	DOC. CONTROL #	RETENTION TIME
THE FOLLOWING RECORDS ARE LOCATED IN **I:\ISO_DOCs\MBOO_Forms\Field Data Sheets**		
6. Mon-obs-i7	MBOO-F-WQ061.1-0602	*Indefinitely*
7. Mon-obs-i8	MBOO-F-WQ062.1-0602	*Indefinitely*
8. southctd	MBOO-F-WQ063.1-0602	*Indefinitely*
E. PLOO Offshore Water Quality		
1. PLOO_Offshore Sampling_Field Sheet_North WQ	MBOO-F-WQ075.0-0903	*Indefinitely*
2. PLOO_Offshore Sampling_Field Sheet_MID WQ	MBOO-F-WQ076.0-0903	*Indefinitely*
3. PLOO_Offshore Sampling_Field Sheet_South WQ	**MBOO-F-WQ077.0-0903**	*Indefinitely*
c. MISC Monthly		
1. Generic	MBOO-F-WQ064.1-0602	*Indefinitely*
2. Overlimits resample	MBOO-F-WQ065.0-0402	*Indefinitely*
3. IWTP	MBOO-F-WQ066.1-0602	*Indefinitely*
4. NPDES-cklst	MBOO-F-WQ067.3-0903	*Indefinitely*

Appendix B

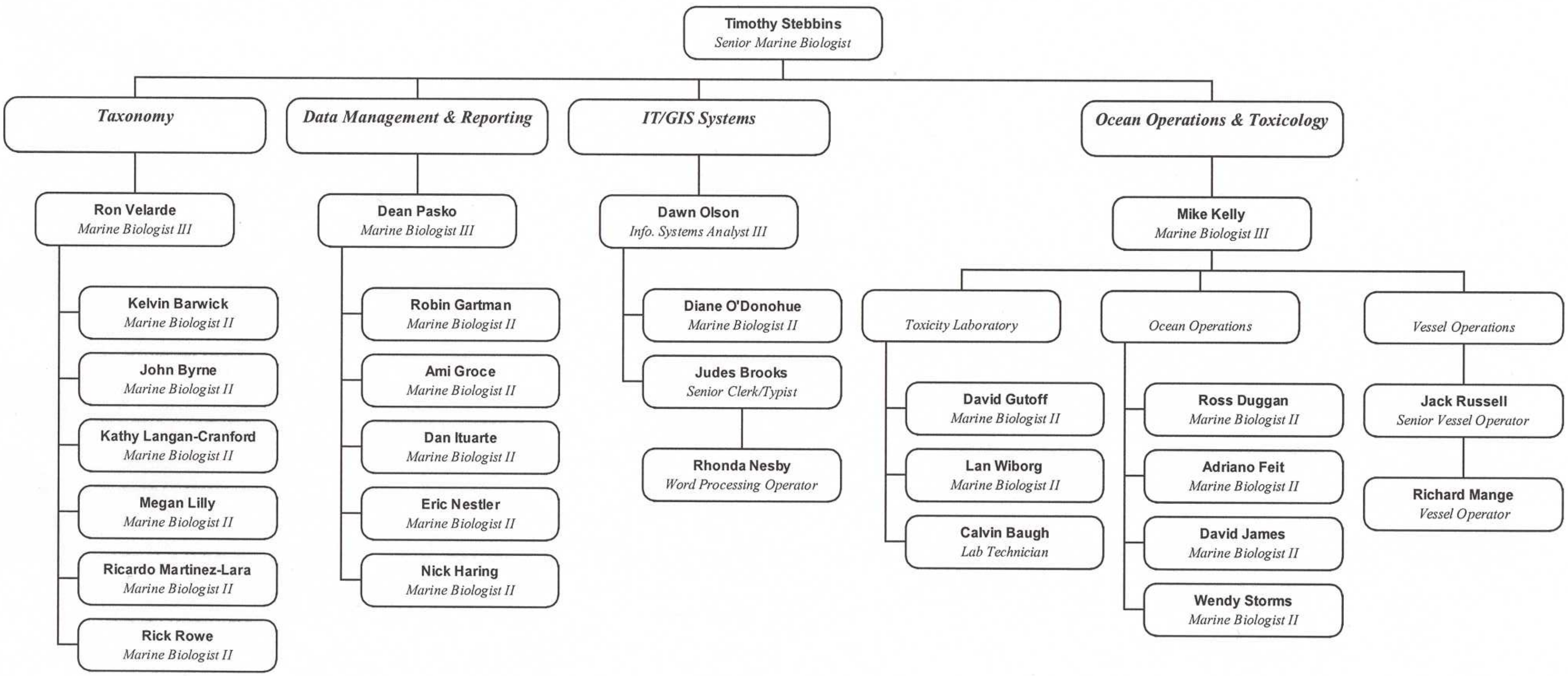
Marine Biology and Ocean Operations Laboratory

Marine Biology and Ocean Operations Laboratory organization, laboratory positions, and staff biographies

City of San Diego
Metropolitan Wastewater Department
Environmental Monitoring & Technical Services Division

Alan Langworthy, *Deputy Director, MWWD/EMTS*
Stan Griffith, *Assistant Deputy Director, MWWD/EMTS*

Marine Biology & Ocean Operations



LABORATORY POSITIONS
FOR MARINE BIOLOGY AND OCEAN OPERATIONS

Following the job descriptions below, a summary of each employee's qualifications is included.

Senior Marine Biologist: Laboratory supervisor responsible for overseeing all marine biology and ocean operations portions of the Ocean Monitoring Program.

Marine Biologist III: Supervisors responsible for all functions of a particular work group. Duties include supervision, coordination with other groups, quality assurance, and oversight of all phases of field and laboratory operations.

Marine Biologist II: Fully trained professionals responsible for all phases of field and laboratory operations. Duties include collection, and identification of marine benthic invertebrates and fishes; marine toxicology; data reduction, analysis and interpretation; and report writing.

Marine Biologist II/Toxicologist: Fully trained professionals responsible for all phases of toxicological testing. Duties include sample collection; performing acute and chronic bioassays on receiving water, influent, effluent, and marine sediments; quality assurance protocols; special studies as required; and report preparation.

Marine Biologist I: Entry-level professionals who are still being trained in some aspects of the City's field and laboratory operations.

Information Systems Analyst III*:* Fully trained professional responsible for the development and maintenance of the GIS application. Synthesis of many disciplines is required, including GIS, marine sciences, geography, computer sciences, and engineering, in order to produce accurate models and visualizations of the data. This position also works on integration of the various data management and analysis tools including Oracle database development.

Laboratory Technician/Toxicology*:* Technical staff responsible for support of routine field sampling and sample processing.

Senior Clerk Typist: Supervisor responsible for all functions of clerical support group. Duties include supervision, coordination with other groups, overseeing data entry procedures and report production.

Word Processing Operator*:* Clerical support staff responsible for all data entry and report production.

Marine Biology & Ocean Operations Staff (MWWD/EMTS)

Timothy D. Stebbins, Ph.D.

Senior Marine Biologist

Tim Stebbins is a marine ecologist whose interests focus on benthic ecology, coastal pollution, crustacean biodiversity, and the ecology and systematics of marine isopods and chitons. He received a Bachelor's degree in Zoology from the University of California Davis in 1978, a Master's degree in Biology from Humboldt State University in 1982, and a PhD in Biology from the University of Southern California in 1988. Dr. Stebbins joined the City of San Diego in 1989 working as a benthic ecologist and invertebrate taxonomist. He became Senior Marine Biologist for the Environmental Monitoring and Technical Services Division, Metropolitan Wastewater Department in 2001. Currently, he is in charge of directing the marine biology and ocean operations portion of the City's Ocean Monitoring Program.

Data Management & Reporting

Dean Pasko

Marine Biologist III

Dean Pasko is the supervisor of the Data Management and Reporting work group of the City's Marine Biology and Ocean Operations Laboratory. He received a B.A. degree in Biology from the Loyola Marymount University, Los Angeles, CA in 1979 and a M.A. degree in Biology from Humboldt State University in 1986. Mr. Pasko joined the City of San Diego as a benthic biologist and taxonomist in 1986. He has experience in many aspects of ocean monitoring (e.g., field sampling, invertebrate taxonomy, bacteriology, data analysis and reporting), but specializes in the ecology and environmental biology of marine benthic invertebrates. He worked as a member of the Taxonomy/Benthic Ecology Group for approximately 10 years before moving into his current position in charge of the Data Management and Reporting Group. His professional interests include marine invertebrate biology and systematics with emphasis on crustacean taxonomy as well as benthic community ecology. Mr. Pasko currently oversees the analysis, interpretation and reporting of receiving waters monitoring data collected by the City's Ocean Monitoring Program.

Robin J. Gartman

Marine Biologist II

Robin Gartman is a marine biologist who specializes in the ecology and environmental biology of marine fish. Ms Gartman began her science career at Palomar Community College where she worked as a Laboratory Aide from1978 to 1979 and was exposed to many aspects of biology, zoology, microbiology, and physiology. She continued with this type of employment in the Physiology Department of San Diego State University (SDSU) from 1980 to 1983 while working towards her Bachelor's degree. She received her B.A. degree in Zoology from SDSU in 1985. While serving as a volunteer Bio/Marine Technician at Scripps Institute of Oceanography (1986 – 1989), Ms Gartman was awarded the rare opportunity to participate in a 4-month expedition to the Antarctic to study copepods. She has worked for several environmental companies including MEC Analytical Systems (1987 – 1988), Kinnetic Laboratories (1988 – 1991), and most recently the City of San Diego Marine Biology and Ocean Operations Laboratory (January 1992 – present). Her primary interests include the assessment of natural and anthropogenic changes in demersal marine fish assemblages off San Diego, and the identification of benthic marine echinoderms and other "minor" phyla (e.g., cnidarians, nemertean and sipunculid worms, flatworms). Robin is currently responsible for analyzing and reporting data regarding demersal marine fish assemblages for the City's Ocean Monitoring Program.

Ami K. Groce
Marine Biologist II

Ami Groce is a marine biologist with the Data Management & Reporting work group specializing in the ecology and environmental biology of marine fishes. She has a B.S. degree in Biology from the University of California San Diego (1992) and a M. S. degree in Biology/Ecology from San Diego State University (2002). Her undergraduate and graduate studies included marine ecology, statistics, and ichthyology. Prior to employment with the City, Ms Groce was an intern in the Marine Life Research Group at the Scripps Institution of Oceanography (1991). She also worked as a research assistant for a small biotech company doing cancer research during her undergraduate career. She has been a marine biologist with the City's Marine Biology and Ocean Operations Laboratory since 1993. In 1998, she returned to school to get her Master's degree in the Biology/Ecology Program at SDSU. Her graduate work focused on the ecology and biochemistry of contaminants in fish species of interest to the City's Ocean Monitoring Program. Her present efforts with the City focus on assessing natural and anthropogenic changes in marine fish assemblages off San Diego, and in monitoring the bioaccumulation of contaminants in the tissues of fishes. In addition to performing the analysis, interpretation and reporting of fish data, Ami identifies benthic polychaete worms, and is one of the lab's more experienced statisticians and technical writers.

Robert Nicholas Haring
Marine Biologist I

Nick Haring joined the City's Ocean Monitoring Program in 2003 as a marine biologist in the Data Management and Reporting work group. He earned a B.S. in Biology at the University of California, Irvine in 1994 and a M.S. in Marine Biology at California State University, Northridge in 2002. Mr. Haring worked as analyst and project manager for an environmental laboratory, Del Mar Analytical, in Irvine, CA (1994 – 1996) and as a marine biologist/instructor at the Orange County Marine Institute (now the Ocean Institute) from 1997 – 1999. His graduate research focused on how physical environmental factors such as light and waves affect the morphology and physiology of benthic organisms. After graduate school, he accepted a Sea Grant Fellowship with the California Coastal Commission assisting the Historic Wetland Mapping Project. Additionally, Nick collaborates on a continuing project monitoring the facilitative effects of the sea urchin *Diadema antillarum* on the growth and survivorship of juvenile corals in Jamaica, West Indies. His duties with the Marine Biology and Ocean Operations laboratory will include the analysis, interpretation and reporting of benthic macrofaunal data, and the identification of benthic echinoderms and minor phyla.

Daniel A. Ituarte

Marine Biologist II

Dan Ituarte is a marine biologist who specializes in marine benthic ecology and taxonomy. He received a B.A. degree in Marine Biology and Chemistry from San Jose State University in 1973 and a M.A. degree in Marine Biology from Sacramento State University in 1981. Mr. Ituarte is currently working on a Global Information Systems (GIS) certificate at San Diego State University. He worked as a benthic scientist and taxonomist (1973 – 1976) while a graduate student at Moss Landing Marine Laboratories and as a benthic biologist, oceanographer, taxonomist and eventually laboratory supervisor at Kinnetic Laboratories (1976 – 1981). Dan joined the City of San Diego as a benthic biologist and taxonomist in 1981. His studies have included analysis of oceanographic events, benthic ecology and sediment chemistry for ocean and estuarine environments in Alaska, and northern and southern California. Mr. Ituarte is currently responsible for the analysis, interpretation and reporting of the physical and chemical aspects of ocean sediments off San Diego. His focus is on the historical aspects of physical ocean water parameters, chemical parameters, and ecological trends on the San Diego ocean shelf. He will be applying GIS techniques to delineate changes over time and differences between sample locations. In addition to these studies, Dan Ituarte is a professional photographer and provides a variety of services to the Environmental Monitoring and Technical Services Division using film and digital techniques.

Eric C. Nestler

Marine Biologist II

Eric Nestler is a marine biologist who specializes in the ecology and environmental biology of marine benthic invertebrates. He received his B.S. degree in Marine and Freshwater Biology from the University of New Hampshire in 1993. Mr. Nestler was a Senior Research Support Specialist for the Environmental Monitoring and Assessment Program – Surface Waters Northeast Lakes Project (1993/1994) before beginning an internship/lab assistant position in the Marine Life Research Group at Scripps Institution of Oceanography (1994-1995). He has been a marine biologist with the City's Ocean

Monitoring Program since 1995, working first in field operations (1995-2001) and currently in the Data Management and Reporting work group. His professional interests are focused on benthic community ecology, environmental monitoring, and the assessment of human impacts on marine ecosystems. Additional areas of study include marine invertebrate systematics with a focus on crustacean taxonomy. Eric is currently responsible for the analysis, interpretation and reporting of benthic macrofaunal data for the City's Marine Biology Laboratory.

Information Technology & GIS Systems

Dawn M. Olson
Information Systems Analyst III

Dawn Olson is an Information Systems Analyst with a strong background in marine biology as well as information technology and GIS (geographic information systems). She joined the City's Ocean Monitoring Program in 2002 as supervisor of the Marine Biology and Ocean Operations Laboratory's Information Technology & GIS Systems work group. She is responsible for implementing computing technologies to improve the digital workflow of the lab as well as conducting spatial analyses and generating cartographic products in support of all reporting efforts. Dawn has a B.A. degree in Marine Biology from UC Santa Cruz and a M.S. degree in Marine Science from the University of South Florida. Her current research involves the integration of GIS applications with more traditional scientific data analysis tools, especially in regard to 3D and 4D data analysis and visualization.

Diane L. O'Donohue
Marine Biologist II

Diane O'Donohue is a marine biologist with background expertise in multiple facets of marine biology. She joined the City of San Diego's Ocean Monitoring Program in 1992. Currently, she is a member of the Information Technology and GIS Systems work group for the Marine Biology and Ocean Operations Laboratory where her primary responsibility is the daily management and maintenance of the lab's Oracle database. Ms. O'Donohue received her B.S. degree in Biology from Old Dominion University in 1986. This was followed by graduate work at the University of California, Long Beach during which time she also joined the Southern California Coastal Water Research Project (SCCWRP). Her current research/interests include GIS applications and the deployment of the City's ocean monitoring data to the web.

Judes Brooks
Senior Clerk

Judes Brooks is a Senior Clerk who has been with the City's Ocean Monitoring Program for 13 years. She is responsible for the production and distribution of various regulatory reports, including the monthly water quality, monthly toxicity, and annual receiving waters monitoring reports and the annual quality assurance manual. As a member of the IT/GIS work group, she is also involved in daily data management of the lab's Oracle database. Additionally, Judes established and is responsible for maintaining the document control system to ensure that the Marine Biology and Ocean Operations section remains compliant with ISO 14001.

Rhonda R. Nesby
Word Processing Operator

Rhonda Nesby is a Word Processing Operator who has been with the City's Ocean Monitoring Program for two years. Rhonda shares responsibility with other IT/GIS clerical staff to ensure accurate and timely data entry for all field-collected data and lab test results. She is also responsible for various aspects of quarterly, semi-annual and annual report production, and shares responsibility for the entire monthly report production process from data entry to report publication and dissemination.

Ocean Operations & Toxicology

Michael J. Kelly
Marine Biologist III

Mike Kelly is the supervising marine biologist in the Ocean Operations group. His group is responsible for operating and maintaining two ocean monitoring vessels, conducting all offshore ocean sampling and diving operations and completing the annual inspections at three ocean outfalls. His group also operates the City's Marine Bioassay Laboratory and performs the permit-mandated marine toxicology testing. He began his undergraduate work in biology at Kansas State University and earned a BA in biology with an emphasis in marine biology at UCSB in 1975. He went on to conduct graduate studies in biological oceanography at Moss Landing Marine Laboratories while matriculating through San Francisco State University. While completing his studies, Mr. Kelly worked for a marine biology consulting firm in Santa Cruz, CA before joining the City in 1984. He began work as biologist specializing in field operations and later became a founding member of the Ocean Operations group. Over time, he became responsible for incorporating newly acquired electronic instrumentation into the City's Ocean Monitoring Program. Some of the systems included the conductivity depth and temperature (CTD) instrumentation, a Remotely Operated Vehicle (ROV) system and the Mission Manager navigation integration and outfall inspection system. Mike promoted to the supervisor position in 2000.

Ross M. Duggan

Marine Biologist II

Ross Duggan is a marine biologist in the Ocean Operations work group. He received his M.S. degree in Biology (emphasis in Marine Ecology) at San Diego State University in 1989 and his B.S. degree in Biology from San Diego State University in 1985. Mr. Duggan began his career with the City in the Marine Biology Laboratory in 1989 as a marine biologist in the Taxonomy work group. His major responsibilities in that position included developing tools to improve taxonomic identifications of marine invertebrates and training new personnel to identify benthic invertebrates. In 1993, he transferred to the Ocean Operations work group and took on the responsibility of coordinating the offshore water quality sampling activities and maintaining the corresponding instrumentation. He is currently responsible for the operation and maintenance of the City's Remotely Operated Vehicle (ROV). Between 1988 and 2001, Ross also worked at Southwestern College as an Adjunct Professor of Biology, teaching courses such as Marine Biology, Oceanography, Botany, Zoology and Introductory Biology. From 1987 to 1989, he worked for the Pacific Estuarine Research Laboratory (PERL) as a Research Assistant. His primary responsibilities at PERL included estuarine floral and faunal surveys, and construction, maintenance and monitoring of artificial wetlands.

Adriano L. Feit

Marine Biologist II

Adriano Feit is a marine biologist whose interests lie within biological oceanography. He received his B.S. degree in Oceanography from Humboldt State University in 2003. Mr. Feit was hired by the City of San Diego's Marine Biology Lab in the Ocean Operations group in 2001. He began his work with the City as an intern in the Lab in 2000 after having completed his tenure with the Ecology Research Group at San Diego State University Foundation. His duties as a research assistant there included identifying riparian vegetation species for a long term monitoring project for the U.S. Marines and developing optimum methods for exterminating invasive exotic species. Adriano also worked for the Pacific Estuarine Research Lab at the San Diego State University Foundation where he worked on the Tijuana River Estuary Model Marsh project. He assisted in collecting fish and invertebrate data for long term monitoring of the Tijuana River Estuary. In 1998-1999, he worked for the Department of Fish and Game at the Mad River Hatchery as a hatchery assistant and as a volunteer with their Riparian Volunteer Project. In 1997, he worked as a student assistant for the Department of Oceanography at HSU on a U.S. Forestry Service funded study investigating the impact of woody debris along the coastline.

David Gutoff

Marine Biologist II/Toxicologist

Dave Gutoff is a marine biologist specializing in marine toxicity studies. He received his B.S. degree in Biology from Cal Poly, San Luis Obispo in 1976. Mr. Gutoff worked as a biologist for the California Department of Fish and Game from 1977-78 studying Pacific herring populations in Tamales Bay. He joined the US Peace Corps from 1978 to 1981 and conducted field surveys to determine suitable sea farming sites in Mindanao, Philippines. When he returned he worked as a field biologist and then laboratory manager at Marine Bioassay Laboratories in Santa Cruz, CA from 1982 to 1990. He then moved to San Diego to work at Coastal Resources Associates in Carlsbad, where he was involved in studying Alaskan echinoderm reproductive impacts from oil spills and developing laboratory *Macrocystis* sporophyte production for use in Southern California artificial reefs. Dave joined the City of San Diego's Marine Biology Laboratory in 1992. He is currently involved with all aspects of the City's permitting and testing programs.

David James

Marine Biologist II

Dave James is a marine biologist whose interests lie within subtidal ecology. He received his M.S. degree in Marine Science from Moss Landing Marine Laboratories in 1998 and his B.A. degree in Aquatic Biology from the University of California Santa Barbara in 1990. Mr. James started working for the City of San Diego Ocean Monitoring Program in 2001 as a member in the Ocean Operations work group. In 2000, Dave was a project supervisor for the UCSB artificial reef mitigation program. From 1998 to 2000, he worked at Scripps Institution of Oceanography, where he investigated faunal recovery in wetlands, the alteration of wetland habitat by exotic invertebrates, and examined animal/sediment and trophic interactions in salt marshes and methane seep communities. Dave has also worked as an environmental consultant for several laboratories, including MEC Analytical Systems (1997), TEG Ocean Services (1997), Kinnetic Laboratories (1995-1996), and Ogden Environmental (1991-1994). In these positions, he collected data on fishes, invertebrates and algae by SCUBA and trawls for various projects, analyzed water quality and sediments for power plant discharge waters, and conducted temporal subtidal surveys and experiments in the Southern California Bight. In 1991, he worked as a fishery technician in the gill net fishery for the National Marine Fisheries Service.

Wendy E. Storms

Marine Biologist II

Wendy Storms is a marine biologist with the Ocean Operations field sampling team. She received her B.A. degree in Marine Biology from the University of California Santa Cruz in 1995, and her M.S. degree in Oceanography from the University of California San Diego (Scripps Institution of Oceanography) in 2000. During her tenure at Scripps, she volunteered with the Birch Aquarium's school outreach program as a "Beach Teacher." Following graduation Wendy continued to work part-time at Scripps as a Staff Research Associate on projects ranging from the physical dynamics of phytoplankton at small scales to the algorithms necessary to ground-truth satellite images. In addition she worked for California State Parks for a year and a half at Torrey Pines State Beach. Hired in 2001 by the City of San Diego, she has focused her energies on streamlining data collection methods and maintaining the integrity of those data.

Lan C. Wiborg
Marine Biologist II/Toxicologist

Lan Wiborg is an aquatic toxicologist who specializes in the characterization of whole effluent toxicity (WET) and toxicity identification evaluations (TIEs). She received her B.S. degree from the University of California Davis in 1993, and is currently completing a M.P.H. degree in Environmental Health at San Diego State University. Ms. Wiborg was a Research Associate at AQUA-Science from 1991-1997, specializing in TIEs, WET testing, stormwater monitoring, agricultural and urban runoff management, study design, and data management. She joined the City as a Toxicologist in 1997. Lan Wiborg is a long time member of both the Northern and Southern California Regional Chapters of the Society of Environmental Toxicology and Chemistry (Nor. Cal. and So. Cal. SETAC). She served as a director of So. Cal. SETAC from 1998-1999 and as treasurer from 2000-2002. She is currently the Vice President of So. Cal. SETAC. As an active member of the San Diego Stream Team's steering committee, Lan also serves as the macroinvertebrate taxonomic identification supervisor and field sampling coordinator for the San Dieguito River watershed. Her studies have focused on the impact of contaminants on environmental and human health in the San Francisco Bay-Delta, San Joaquin Valley, and the Tijuana River/Estuary System. Her present research efforts focus on WET method validation, watershed management, and volunteer monitoring data validation.

Calvin Baugh
Laboratory Technician

Calvin Baugh is a Lab Technician for the Ocean Operations and Toxicology work group. He has worked for the Environmental Monitoring & Technical Services Division for over 12 years. He received his B.S. Management degree at the University of Phoenix in 2002 and an A.S. in Biology from San Diego Community College in 1992. Mr. Baugh started working with the City of San Diego in the Marine Microbiology Laboratory where he sampled the coastal waters from Mission Bay to Imperial Beach for required coliform testing. He performed such duties a media preparation, boat duty, and plate counting. He transferred to the Marine Biology Laboratory in 1994, where he currently performs toxicity water quality testing, effluent sampling, delivery and pickup, and boat duty associated with the City's monitoring program. Calvin earned the rank of a Sergeant while supervising the Water Purification Specialists within the Army Corp of Engineers from 1978-1982.

John Russell
Senior Boat Operator

John Russell is the senior boat operator for the City's Ocean Monitoring Program. He has a U.S. Coast Guard 100 ton Masters License with a towing endorsement and radar certification. Mr. Russell received his coastal mariner's license in 1992 and took coursework at the Southern California Merchant Marine Training Service. He has been the senior boat operator with the City since 1988 and was a boat operator for the City from 1985-1988. Prior to this work, he was an equipment technician with the City from 1979-1985. He worked as a marine electrician at the National Steel and Ship Building Company from 1972-1974. Mr. Russell was an engineering aide at Scripps Institution of Oceanography from 1967-1971, where he was a crew member aboard the R/P Flip and R/V Conestoga. At Scripps, he assisted with building and deploying physical oceanography equipment. From 1963 to 1967, he was an Optical Man in the U.S. Navy where he overhauled and repaired navigational equipment. He was and is an American patriot.

Richard Mange
Boat Operator

Richard Mange is a boat operator for the City's Ocean Monitoring Program. He has his U.S. Coast Guard 100 ton Master's License with a towing endorsement. Mr. Mange completed coursework with the Southern California Merchant Marine Training Services in 1993 and attended the Mariner's License Prep school in 1984. He has been a boat operator with the City since 1988. Prior to this work, Richard was a tug boat operator and sea trial team member at National Steel and Ship Building Co. from 1976-1988. He was a Boatswain's Mate with the U.S. Navy from 1969-1973.

Taxonomy

Ronald G. Velarde
Marine Biologist III, Supervisor

Ron Velarde is the supervisor of the Taxonomy section of the Ocean Monitoring Program for the City of San Diego. He received a Bachelor of Science degree in Marine Biology from California State University Long Beach in 1976. He has worked for the City since 1983. His major interests are in the taxonomy and ecology of benthic marine invertebrates, especially polychaetes and opisthobranchs, and the relationships of each species to the benthic communities.

Kelvin L. Barwick
Marine Biologist II

Kelvin Barwick is a taxonomist for the City of San Diego's Ocean Monitoring Program specializing in mollusks and polychaetes. He has nearly 20 years of professional experience in the public and private sector. Mr. Barwick received a Bachelor of Science degree in Wildlife and Fisheries Science from Texas A&M University in 1983.

John T. S. Byrne, Jr.
Marine Biologist II

John Byrne is a marine biologist in the City of San Diego Marine Biology Laboratory's Taxonomy work group specializing in Crustacea. He graduated from the University of California San Diego in 1976. He has worked for the City since October 1989. Prior to his current position, Mr. Byrne worked in the Data Management and Reporting work group as the report production editor. He has also worked for the Marine Review Committee and the Scripps Institute of Oceanography. John is also a licensed boat captain.

Kathleen M. Langan-Cranford
Marine Biologist II

Kathy Langan-Cranford is a marine biologist for the City of San Diego's Ocean Monitoring Program. She received an undergraduate degree in Biology in 1982 and a Master of Science in Marine Sciences from the University of California, Santa Cruz in 1984. She has worked for the City for 10 years. She is a member of the Taxonomy work group and specializes in the taxonomy of polychaetes and echinoderms.

Megan B. Lilly
Marine Biologist II

Megan Lilly has been a marine biologist for the City of San Diego since 1993. She graduated with a B.S. in Biology from Humboldt State University in 1991. Her specialties include the taxonomy of the Echinodermata, Mollusca (with an emphasis on Cephalopoda) and miscellaneous phyla. Megan has served as the secretary of SCAMIT (Southern California Association of Marine Invertebrate Taxonomists) since 1998.

Ricardo Martinez-Lara
Marine Biologist II

Ricardo Martinez is an organismal biologist specializing in the taxonomy and systematics of benthic fauna, especially polychaetous annelids, and the ecology of seafloor community dynamics. He obtained his undergraduate B. Sc. degree in Biology from San Diego State University in 1992. Ricardo joined the City of San Diego Marine Biology Lab in January 1992. Previously, he was a research associate at the Scripps Institution of Oceanography working on the systematics of deep-sea benthic organisms, and as a research assistant at San Diego State University working in the Pacific Estuarine Research Laboratory. His current research interests include two broad and closely related concepts: (1) the process of describing benthic biodiversity (especially of polychaete worms) and exploring the role of species in their environment; (2) understanding benthic community dynamics as a metric of habitat condition, the role of benthic fauna as continuous monitors of their environment through space and time, and how these relate to the current state of marine ecosystems in the Southern California Bight.

Richard C. Rowe

Marine Biologist II

Rick Rowe has been a marine biologist with the City of San Diego since 1993. Employed primarily as the lead polychaetous annelid taxonomist with the City's Marine Biology and Ocean Operations Laboratory, Mr. Rowe's recent contributions include the application of computer technology to taxonomy. He received his B.S. (1972) and M.S. (1975) degrees in Marine Biology from California State University at Long Beach. His Master's thesis on the effects of sewage discharge on polychaetous annelids provided the basis for his interest in anthropogenic impacts on marine organisms. Rick has worked for private consulting companies, as a research associate at the Allan Hancock Foundation, University of Southern California, and as a self-employed taxonomic consultant. To improve the quality of taxonomic data utilized by the City, he actively participates in the taxonomic standardization efforts of the Southern California Association of Marine Taxonomists (SCAMIT), has acquired expertise in digital imagery to record and report invertebrate morphology, and is applying database management to descriptive (morphological) data.

Appendix C

Marine Microbiology
and
Vector Management Laboratory

Marine Biology and Vector Management Laboratory organization,
laboratory positions, and staff biographies

City of San Diego
Metropolitan Wastewater Department
Environmental Monitoring & Technical Services Division

Alan Langworthy, ***Deputy Director, MWWD/EMTS***
Stan Griffith, ***Assistant Deputy Director, MWWD/EMTS***

Marine Microbiology & Vector Management

- **Ricardo Amador** — *Senior Biologist*
  - **Laila Othman** — *Biologist III*
    - ***Marine Microbiology***
      - **George Alfonso** — *Biologist II*
      - **Roxanne Davis** — *Biologist II*
      - **Sonji Romero** — *Biologist II*
      - **Joseph Toctocan** — *Biologist II*
      - **VACANT** — *Biologist I*
      - **Jason Edwards** — *Laboratory Technician*
      - **Nestor Malibago** — *Laboratory Technician*
      - **Rumana Shahzad** — *Laboratory Technician*
      - **Dave Straup** — *Laboratory Technician*
      - **Zakee Shabazz** — *Asst. Laboratory Technician*
    - ***Vector Management***
      - **Andre Macedo** — *Biologist II*
      - **Toby Brown** — *Laboratory Technician*

LABORATORY POSITIONS
FOR MARINE MICROBIOLOGY & VECTOR MANAGEMENT

Following the job descriptions below, a summary of each employee=s qualifications is included.

Senior Biologist: Laboratory supervisor responsible for overseeing the Marine Microbiology Laboratory and Vector Management Program.

Biologist III: Supervisors responsible for all functions of a particular group. Duties include supervision, coordination with other groups, quality assurance, and all phases of field and laboratory operations.

Biologist II: Fully trained professionals responsible for all phases of microbiological analyses. Duties include analysis of receiving waters, watersheds, and effluent for total coliform, fecal coliform, *E. coli* and enterococci bacteria. Microbiological analysis of biosolids; laboratory water quality analysis; design and performance of special projects as requested. Are Aon call@ for 7/24 emergency response.

Biologist II/Entomologist: Fully trained professionals responsible for all phases of entomological field and laboratory operations. Duties include sampling, monitoring, specimen collecting, taxonomic identification, and curating of vector borne arthropods and other aquatic insects; is State Certified to handle and apply pesticides for the control of mosquitoes and other invertebrates. Evaluates and reports entomological data.

Biologist I: Entry-level professionals who are still being trained in some aspects of the City's field and laboratory operations.

Laboratory Technician/Microbiology: Technical support staff responsible for sample collection and Microbiology preparation activities. Duties include quality assurance of all field and prep-room equipment, processes, instrumentation and other supplies; maintains stock of prep-room and microbiology supplies; conducts media preparation, dispensing, labeling and quality control; uses and maintains City vehicles and watercraft; assists with sample site assessment and selection; conducts routine bacteriological analyses under guidance of professional staff. Are Aon call@ for 7/24 emergency response.

Laboratory Technician/Entomology: Technical staff responsible for support of routine data collection and reporting of vector borne disease and mosquito monitoring within the Entomology Section. Performs larval identification of mosquitoes and maintains sentinel chicken flock used in viral encephalitis surveillance. Trained in all phases of bioassessment (sampling, sorting, family level taxonomic identification). Maintains all sampling equipment.

Assistant Laboratory Technician: Technical support staff responsible for equipment and supply transport, preparation of media and glassware for field and laboratory operations, and field sampling.

Marine Microbiology and Vector Management Laboratory
(MWWD/EMTS)

Ric Amador
Senior Biologist

Ric Amador is a Senior Biologist and manages the Marine Microbiology and Vector Management Groups. He received his B.S. degree in Zoology at San Diego State University in 1975. He served in the U.S. Army, was an Environmental Health Technician Course graduate and worked as a Health and Environment Technician from 1975 to 1978. During this time he completed Environmental Health coursework offered by Baylor University. While in the Army Ric conducted a variety of health related surveys, inspections and investigations and performed bacteriological tests on water and wastewater samples. Ric began his career with the City in the Water Department Water Quality Lab as a Microbiologist in 1978. His responsibilities included bacteriological, chemical and plankton sampling and analyses appropriately applied to water samples from raw drinking water sources, water treatment plants, potable water distribution systems, reclamation plants, sewage sources and wells. In 1989 Ric promoted to supervisor of the Water Quality Microbiology Lab. Ric developed procedures for handling water quality complaints, a protocol for new main training, sampling and testing as well as helping to design the microbiology database. He led the implementation of the Total Coliform Rule sample siting plan and coordinated the lab's effort in the Mission Bay Rainfall Study. In 1997 Ric transferred to the Metropolitan Wastewater Department to supervise the Marine Microbiology and Vector Management group. He directed the group's work for the Bight'98, Bight'03, EPA Empact and Bonair Storm Drain studies. He is the project manager for the Mission Bay Water Quality Supplemental Environmental Project. Ric promoted to Senior Biologist in 2001.

Marine Microbiology

Laila Othman
Biologist III

Laila Othman is the supervising Biologist for the Marine Microbiology and Vector Management Section. She received a B.A. in Chemistry at San Diego State University in 1995, an A.S. in Liberal Arts from Southwestern Community College in 1992 , and an A.S. in Pharmacy at Ramallah Women's Training Center (Junior College). Laila began her career with the city in 1989 as an Assistant Laboratory Technician responsible for media preparation, and field sampling. In 1996, she was promoted to Biologist I/II and performed bacterial and viral analyses of environmental water samples. Her primary responsibilities included membrane filtration, multiple tube fermentation, chromogenic, and phage analyses, in addition to participating in special and regional studies. In 2002, Laila was promoted to Biologist III, responsible for supervising a large and varied section. Laila also plays an important role in the City's Diversity Program and produces the Division's Diversity newsletter.

George B. Alfonso
Biologist II

George Alfonso is a Microbiologist in the Marine Microbiology and Vector Management Section. George received his B. S. in Medical Technology degree in 1975 at St. Louis University, in the Philippines. He immediately began employment with the Bureau of Research and Laboratories of the Department of Health in the Philippines, where he worked in the rabies vaccine production for both human and veterinary use. In 1978, George went to work for the Microbiology section of Nestle Philippines, until leaving for Saudi Arabia in 1982. He worked for sometime in the flour milling industry as a shift technician in the quality control laboratory, and then in the Water Quality Laboratory of the Water Treatment Plant for King Khalid International Airport in Riyadh, Saudi Arabia. In 1991, George brought his family to the United States and worked as a laboratory technician at Pacific Treatment and Analytical Services. He came to the City in 1991 to work as Biologist I in the Water Quality Laboratory of the Water Department. Besides his regular lab work, he became involved in the development on the new database system (LIMS) for the Water Quality Laboratory of Water Department. He joined the Marine Microbiology and Vector Management Group in 1999.

Roxanne Davis
Biologist II

Roxanne Davis is a biologist in the Marine Microbiology and Vector Management Section. She received her B.S. in Microbiology at San Diego State University in 1986 and her A.S. in Animal Health Technology at San Diego Mesa Community College in 1981. Roxanne began her career with the City as an Assistant Laboratory Technician in the Industrial Waste Laboratory in 1991, where she was responsible for field sampling and testing. In 1994, she was promoted to Biologist I with the Marine Microbiology Section. Her primary responsibilities include bacterial and viral analyses on ocean, shoreline, stormdrain, and tributary water samples using membrane filtration, multiple tube fermentation, IDEXX, and phage analyses. Roxanne also creates and updates the lab's SOPs and orders all supplies for the laboratory. Roxanne has also worked for The Salk Institute in 1985, preparing tissue culture media and for Scripps Clinic and Research Foundation from 1987-1989, conducting experiments for cancer research that involved tissue culture, monoclonal antibody production, and DNA/RNA preparations. In 1991, she worked as a research technician at the San Diego State University Foundation and performed injections, blood collection, and surgeries while studying fetal alcohol syndrome in laboratory rats.

Sonji E. Romero
Biologist II

Sonji Romero is a biologist for the Marine Microbiology and Vector Management Section. Her duties include bacteriological/viral analyses of various environmental receiving waters, storm water, wastewater, sludge, and solids. These analyses include Membrane Filtration, Multiple Tube Fermentation, and chromogenic substrate analyses. In 1992, she received her B.S. Degree in Microbiology from SDSU. Prior to becoming a biologist with the Marine Microbiology section, Sonji worked as a Lab Technician for Wastewater Chemistry where her duties included washing laboratory glassware, performing TKN analyses and pesticides extraction, and sample collection. Sonji has also worked as a chemist with Analytical Technologies, Inc., as a VOC Gas Chromatography Chemist, where she performed Purge and Trap (EPA 601/602, 8010/8020/8021, 501/501) analyses on various industrial and environmental matrices, GC maintenance, data input and review. She also works as a volunteer coordinating the Water Quality section of the San Diego Regional Science Olympiad, and is an active member of the San Diego Stream Team, sampling for BMI and chemistries in Peñasquitos Creek and the San Diego River.

Joseph Toctocan
Biologist II

Joseph Toctocan is a biologist in the Marine Microbiology and Vector Management Section. He received his B. S. degree in Biology from St. Louis University, Baguio City, Philippines in 1980. He started his career with the City of San Diego, in October 1993 as a laboratory technician for the Water Department. He transferred to his present position in September 2001 where he performs bacteriology tests (HPC, MPN, Colilert and MF) for the ocean and storm drain monitoring programs, reclaimed water processing plants, and other special studies. In the Philippines, he worked as a medical laboratory manager before immigrating to the U.S.A. in 1993. Joseph is also certified as a Medical Assistant, EKG operator and Phlebotomist in the state of California, and has worked as a Medical Assistant at the Amigo Medical Clinic in Chula Vista and a Medical Assistant instructor at the Pima Medical Institute in San Diego, CA. Joseph has also provided medical volunteer service for the San Ysidro Health Center and the Paradise Valley Hospital in National City, CA.

Jason Edwards
Laboratory Technician

Jason Edwards is a Laboratory Technician for the Marine Microbiology and Vector Management section. He received his BA degree in Environmental Studies from U.C. Santa Barbara in 1998. He started working in the Marine Microbiology group in December 2002. He joined the City of San Diego in 2000 working in the Industrial Waste Laboratory, as a laboratory technician, where he sampled and analyzed wastewater from most of the permitted industries in San Diego. From 1998 to 2000 he was a field technician for a small environmental laboratory, Pacific Treatment Analytical Services. He sampled and analyzed water and wastewater from various sources and agencies in San Diego. His current work with the Marine Microbiology group entails media preparation and field sampling.

Nestor Abenojar Malibago
Laboratory Technician

Nestor Abenojar Malibago is a Laboratory Technician in the Marine Microbiology and Vector Management Section. He was in his fourth year in B.S. Mechanical Engineering at Saint Louis University, Philippines when he joined the U.S. Navy and was classified as a Boiler Technician until December 1995. He received his Water/Wastewater Technology certificate at Mesa College, San Diego in June 1997. In May of 1996, Nestor began his career in the City as Utility Worker I in the Metropolitan Wastewater Department, Collections Division. In June 1998, he was hired in the Industrial Waste Laboratory as a Laboratory Technician. Nestor transferred to Marine Microbiology and Vector Management Section in October 2002. His responsibilities include media and reagent preparation, quality assurance and control, shore and bay sampling, supply inventory and maintenance, preparation and transport of reusable supplies, and media and buffer water preparation. He is also on call to respond to accidental sewage spills investigations, participates in sample site assessment and G.P.S. verification, and assists Marine Microbiologists in routine analysis as required.

Zaira Rodriguez
Laboratory Technician

Zaira Rodriquez is a Laboratory Technician in the Marine Microbiology and Vector Management Section. She received her B. S. as Pharmacobiological Chemist (1995) and Industrial Chemist (1987) at UABC (Campus Tijuana, Mexico). Zaira started her career working at Hospital IMSS in Tijuana as a Chemist and Microbiologist in the areas of Microbiology, Parasitology, Serology, Immunology, Endocrinology, Clinical Chemistry, Blood Bank and Hematology. While at Hospital IMSS, she performed two research projects: “Sensitivity to Antibiotics of Bacteria Isolated in the Hospital” and “Retrospective Study of Antibodies against CMV in Patients in the Hospital” (1988-1999). From 1999 to 2002, Zaira worked at the San Diego County Public Health Laboratory as a Laboratory Assistant. Her main duties at the county laboratory included performing IDEXX, MPN, and QA/QC analysis on water samples, along with other duties in the area of mycobacteria isolation, serology, and parasitology. She also participated in two Bi-national Projects in Tijuana and San Diego for the San Diego County Health and Human Services. Zaira started her career with the City of San Diego in January 2003 as a Laboratory Technician in the Marine Microbiology and Vector Management Section. Her primary responsibilities include sampling for the receiving waters monitoring programs, performing QA/QC of materials and supplies necessary for the microbiological analysis of water, and providing analytical help to the Biologists as needed. Zaira has also participated in the Epidemiological Study in Mission Bay and Southern California Bight projects.

Rumana Shahzad
Laboratory Technician

Rumana Shahzad is a Laboratory Technician in the Marine Microbiology and Vector Management section. Her main duties include media, glassware and buffer water preparations, QA analysis, field sampling of ocean and bay waters, and participation in special projects and regional studies. Rumana has a Masters degree in Clinical Microbiology from the University of Karachi in Pakistan, and her Professional Certificate in Occupational Health and Safety from the University of California San Diego (1997). She is currently completing her Graduate Certificate from the University of California San Diego/Alliant. Rumana worked as a Laboratory Technician in the Industrial Waste laboratory from 1994-2003, where she entered organic chemistry and field sampling data accurately into the LIMS system, designed Chain Of Custody forms, reviewed SOPs, and conducted hazardous materials disposals of solvents under ISO protocol. She also performed tests on wastewater for flash point, pH, conductivity, sulfides, Organic extractions/Concentrations for Base neutral Acids, Pesticides and Voc. Rumana also has experience with field sump inspections and industrial wastewater sampling, and has four years of experience working as an Analytical Chemist at Analytical Technologies in San Diego. She also has extensive Medical Technology background, and worked at SharpRees Stealy for four years as well as with leading doctors offices.

Glenn David Straup
Laboratory Technician

David Straup is a Laboratory Technician in Marine Microbiology and Vector Management Section. He has been with this section for over ten years. David graduated from Palomar Community College with an A.A. in General Studies in 1993, with an emphasis on the sciences. In 1994, he started working for the Marine Microbiology Section as an Assistant Lab Technician and was promoted to Laboratory Technician in 1996. His current laboratory duties include quality assurance and quality control on all the products produced in the Prep room for microbiological analysis, assisting the microbiologist as needed, media preparation, supply preparation, supply inventory, and updating SOP's. In the field, his duties include locating new sample sites, sampling permitted shoreline stations, and being on call for spill investigations. David has participated in many special projects including the Southern California Bight regional studies, a summer Epidemiology study of East Mission Bay, special sampling of the Tijuana River and Los Penasquitos Lagoon, a special environmental project of the East Mission Bay Watershed, and an EMPACT study of Imperial Beach and Round Robin Groundwater study for the E.P.A.

Zakee Shabazz
Assistant Laboratory Technician

Zakee is as Assistant Laboratory Technician in the in the Marine Microbiology and Vector Management Section. He served as a Hospital Corpsman and Preventive Medicine Technician in the U.S. Navy for seventeen years. His areas of expertise included microbiology, environmental health, occupational health, and water/wastewater treatment. As a Hospital Corpsman, Zakee collected water samples from shore and ship stations, sterilized surgical instruments, and prepared membrane filtration equipments and supplies. He started his career with the City in 1997. Currently, his main duties include field sampling of ocean, bay and creek waters, glass ware and media preparation, supplies and samples transportation.

Vector Management

André S. Macedo
Biologist II

André Macedo is a Biologist in the Marine Microbiology and Vector Management Section. Andrés primary area of responsibility include the prevention and control of insects of medical importance and that are capable of transmitting diseases to humans, such as mosquitoes and flies. He is also trained as a First Responder in situations involving fire ants and Africanized honeybee attack. André graduated in 1990 from SDSU with a B.S. in Biology, and since 1993 has been certified by the California DHS's Vector Borne Disease Control Section as a Vector Control Specialist. He started working for the City in 1989 as a Student Intern at the AQUA II Project. He became a Biologist in 1995 after serving as an Administrative Intern and Laboratory Technician in the Organic Chemistry and Entomology work groups. Between 1997 and 2000, André worked as a Special Adviser to the Federal Ministry of Health of Brazil, and for the Health Departments of the Brazilian states of Pernambuco and Bahia. Currently André is responsible for all aspects of vector monitoring and control at all MWWD's wastewater, water reclamation, and sludge processing facilities.

Toby G. Brown
Laboratory Technician

Toby Brown is a Laboratory Technician in the Marine Microbiology and Vector Management Section. During his more than 12 years with the City of San Diego, Toby has worked for the Industrial Waste Laboratory, the Water Quality Microbiology Laboratory, and now the Marine Microbiology and Vector Management Laboratory. During the course of this time Toby has been certified by the California Department of Health Services as a Category B Vector Control Technician and a Grade II Water Treatment Operator. He has also completed courses for Investigation of Environmental Crimes and California Stream Bioassessment Procedures. Prior to coming to the City of San Diego, Toby worked as Pilot Plant Operator, Production Supervisor, Assistant QC Manager, QC/QA Technician, Shift Chemist, Carbonation Operator, Bench Chemist, Sample Carrier, and a Swamper/Loader. Although Toby's educational goals have been put on hold due to family priorities, he still plans to return to finish his four year degree where he has already accumulated over two hundred semester units and an AA in Business Administration as well as an AA in General Studies.

Appendix D

Sampling Station Information

Station listing for the Point Loma Ocean Outfall and South Bay Ocean Outfall receiving waters monitoring programs sampled during 2003, including station designation, depth, position (latitude/longitude), and the types of samples collected at each station

City of San Diego Ocean Monitoring Stations (2002)

Point Loma Ocean Outfall [a]

Station	Depth (m)	Latitude	Longitude	Type of Sampling [b]		
				Water	Benthic	Fish
A1	18	32^0 39.56	117^0 15.72	x		
A6	18	32^0 41.56	117^0 16.18	x		
A7	18	32^0 40.53	117^0 16.01	x		
A11 [c]	49	32^0 39.98	117^0 16.27	x		
A13 [c]	47	32^0 40.97	117^0 16.57	x		
A17 [c]	61	32^0 40.33	117^0 16.98	x		
B8	88	32^0 45.50	117^0 20.77	x	x	
B9	98	32^0 45.33	117^0 21.70	x	x	
B10	116	32^0 45.22	117^0 22.16	x	x	
B11	88	32^0 46.57	117^0 21.35	x	x	
B12	98	32^0 46.36	117^0 22.30	x	x	
C4	9	32^0 39.95	117^0 14.98	x		
C5	9	32^0 40.75	117^0 15.40	x		
C6	9	32^0 41.62	117^0 15.68	x		
C7	18	32^0 42.98	117^0 16.33	x		
C8	18	32^0 43.96	117^0 16.40	x		
E1	88	32^0 37.53	117^0 18.35		x	
E2	98	32^0 37.45	117^0 19.09	x	x	
E3	116	32^0 37.29	117^0 20.09		x	
E5	98	32^0 38.38	117^0 19.28	x	x	
E7	88	32^0 39.00	117^0 18.65	x	x	
E8	98	32^0 38.91	117^0 19.34	x	x	
E9	116	32^0 38.75	117^0 20.06	x	x	
E11	98	32^0 39.40	117^0 19.42	x	x	
E14	98	32^0 39.94	117^0 19.49	x	x	
E15	116	32^0 39.88	117^0 19.91	x	x	
E17	98	32^0 40.48	117^0 19.54	x	x	
E19	88	32^0 41.04	117^0 19.18	x	x	
E20	98	32^0 40.96	117^0 19.67	x	x	
E21	116	32^0 40.89	117^0 20.00	x	x	
E23	98	32^0 41.47	117^0 19.77	x	x	
E25	98	32^0 42.38	117^0 20.07	x	x	
E26	98	32^0 43.82	117^0 20.57		x	
F01	18	32^0 38.26	117^0 14.42	x		
F02	18	32^0 45.42	117^0 16.36	x		
F03	18	32^0 46.91	117^0 16.35	x		
F04	60	32^0 35.67	117^0 16.13	x		
F05	60	32^0 36.70	117^0 16.18	x		
F06	60	32^0 37.85	117^0 16.42	x		
F07	60	32^0 39.07	117^0 16.80	x		

City of San Diego Ocean Monitoring Stations (2002)

Point Loma Ocean Outfall [a]

Station	Depth (m)	Latitude	Longitude	Type of Sampling [b] Water	Benthic	Fish
F08	60	32^0 40.33	117^0 16.98	x		
F09	60	32^0 41.13	117^0 17.18	x		
F10	60	32^0 42.33	117^0 17.44	x		
F11	60	32^0 43.53	117^0 17.68	x		
F12	60	32^0 44.80	117^0 18.12	x		
F13	60	32^0 45.92	117^0 18.43	x		
F14	60	32^0 46.89	117^0 18.69	x		
F15	80	32^0 35.65	117^0 17.19	x		
F16	80	32^0 36.71	117^0 17.40	x		
F17	80	32^0 37.80	117^0 17.65	x		
F18	80	32^0 38.99	117^0 17.90	x		
F19	80	32^0 40.07	117^0 18.41	x		
F20	80	32^0 41.13	117^0 18.66	x		
F21	80	32^0 42.23	117^0 19.12	x		
F22	80	32^0 43.36	117^0 19.25	x		
F23	80	32^0 44.51	117^0 19.83	x		
F24	80	32^0 45.67	117^0 20.19	x		
F25	80	32^0 46.74	117^0 20.62	x		
F26	98	32^0 35.63	117^0 18.73	x		
F27	98	32^0 36.71	117^0 19.28	x		
F28	98	32^0 37.76	117^0 19.42	x		
F29	98	32^0 38.87	117^0 19.50	x		
F30	98	32^0 39.94	117^0 19.49	x		
F31	98	32^0 41.08	117^0 19.70	x		
F32	98	32^0 42.09	117^0 20.05	x		
F33	98	32^0 43.23	117^0 20.40	x		
F34	98	32^0 44.33	117^0 20.96	x		
F35	98	32^0 45.46	117^0 21.80	x		
F36	98	32^0 46.61	117^0 22.47	x		
D4	shore	32^0 39.94	117^0 14.62	x		
D5	shore	32^0 40.85	117^0 14.94	x		
D7	shore	32^0 43.16	117^0 15.44	x		
D8	shore	32^0 44.22	117^0 15.32	x		
D9	shore	32^0 44.80	117^0 15.24	x		
D10	shore	32^0 44.95	117^0 15.18	x		
D11	shore	32^0 45.24	117^0 15.16	x		
D12	shore	32^0 46.28	117^0 15.21	x		
SD7	100	32^0 35.06	117^0 18.39			x
SD8	100	32^0 37.54	117^0 19.37			x
SD10	100	32^0 39.16	117^0 19.50			x

City of San Diego Ocean Monitoring Stations (2002)

Point Loma Ocean Outfall [a]

Station	Depth (m)	Latitude	Longitude	Type of Sampling [b]		
				Water	Benthic	Fish
SD12	100	32 ⁰ 40.65	117 ⁰ 19.81			x
SD13	100	32 ⁰ 42.83	117 ⁰ 20.25			x
SD14	100	32 ⁰ 44.30	117 ⁰ 20.96			x
RF1	107	32 ⁰ 40.32	117 ⁰ 19.78			x
RF2	96	32 ⁰ 45.67	117 ⁰ 22.02			x

[a] Point Loma Metropolitan Wastewater Treatment Plant (NPDES Permit No. CA0107409, Order No. R9-2002-0025)

[b] Water sampling = bacteria, physical and chemical seawater parameters
Benthic sampling = sediments and macrobenthic invertebrates (Van Veen grab)
Fish sampling = otter trawls (demersal fish & megabenthic invertebrates) and rig fishing (fish)

[c] Voluntary stations

City of San Diego Ocean Monitoring Stations (2002)

South Bay Ocean Outfall [a]

Station	Depth (m)	Latitude	Longitude	Type of Sampling [b]		
				Water	Benthic	Fish
I1	60	32 º 28.400	117 º 16.620	x	x	
I2	32	32 º 28.400	117 º 11.940	x	x	
I3	27	32 º 28.020	117 º 10.080	x	x	
I4	18	32 º 28.300	117 º 08.400	x	x	
I5	14	32 º 28.300	117 º 07.800	x		
I6	26	32 º 29.610	117 º 09.780	x	x	
I7	52	32 º 31.000	117 º 15.180	x	x	
I8	36	32 º 31.000	117 º 12.120	x	x	
I9	29	32 º 30.700	117 º 10.740	x	x	
I10	19	32 º 31.000	117 º 09.360	x	x	
I11	13	32 º 30.800	117 º 08.220	x		
I12	28	32 º 31.970	117 º 10.980	x	x	
I13	38	32 º 32.250	117 º 12.720	x	x	
I14	28	32 º 32.580	117 º 11.040	x	x	
I15	31	32 º 32.270	117 º 11.340	x	x	
I16	28	32 º 32.270	117 º 10.980	x	x	
I17	25	32 º 32.270	117 º 10.680	x		
I18	19	32 º 32.170	117 º 09.660	x	x	
I19	10	32 º 32.180	117 º 07.740	x		
I20	55	32 º 33.420	117 º 15.420	x	x	
I21	41	32 º 33.640	117 º 13.620	x	x	
I22	28	32 º 33.200	117 º 11.100	x	x	
I23	21	32 º 33.050	117 º 09.900	x	x	
I24	11	32 º 33.400	117 º 08.700	x		
I25	9	32 º 33.670	117 º 08.880	x		
I26	9	32 º 34.470	117 º 08.820	x		
I27	28	32 º 34.450	117 º 11.460	x	x	
I28	55	32 º 35.630	117 º 15.840	x	x	
I29	38	32 º 35.670	117 º 13.380	x	x	
I30	28	32 º 35.720	117 º 11.820	x	x	
I31	19	32 º 35.730	117 º 10.320	x	x	
I32	10	32 º 35.680	117 º 08.280	x		
I33	30	32 º 37.430	117 º 14.220	x	x	
I34	19	32 º 37.800	117 º 12.960	x	x	
I35	19	32 º 38.200	117 º 10.920	x	x	
I36	11	32 º 38.350	117 º 09.240	x		
I37	12	32 º 38.880	117 º 12.980	x		
I38	11	32 º 40.130	117 º 11.200	x		
I39	18	32 º 34.340	117 º 10.050	x		
I40	10	32 º 33.230	117 º 08.170	x		

City of San Diego Ocean Monitoring Stations (2002)

South Bay Ocean Outfall [a]

Station	Depth (m)	Latitude	Longitude	Type of Sampling [b]		
				Water	Benthic	Fish
S0	shore	32 ^{0} 25.148	117 ^{0} 05.837	x		
S1	shore	32 ^{0} 28.218	117 ^{0} 07.260	x		
S2	shore	32 ^{0} 29.922	117 ^{0} 07.380	x		
S3	shore	32 ^{0} 31.542	117 ^{0} 07.440	x		
S4	shore	32 ^{0} 32.118	117 ^{0} 07.500	x		
S5	shore	32 ^{0} 33.468	117 ^{0} 07.860	x		
S6	shore	32 ^{0} 33.978	117 ^{0} 07.980	x		
S8	shore	32 ^{0} 38.208	117 ^{0} 08.640	x		
S9	shore	32 ^{0} 40.620	117 ^{0} 10.680	x		
S10	shore	32 ^{0} 32.598	117 ^{0} 07.500	x		
S11	shore	32 ^{0} 33.678	117 ^{0} 07.920	x		
S12	shore	32 ^{0} 35.142	117 ^{0} 07.980	x		
SD15	27	32 ^{0} 28.350	117 ^{0} 10.500			x
SD16	27	32 ^{0} 31.000	117 ^{0} 10.720			x
SD17	30	32 ^{0} 32.200	117 ^{0} 11.430			x
SD18	30	32 ^{0} 32.580	117 ^{0} 11.350			x
SD19	28	32 ^{0} 33.500	117 ^{0} 11.080			x
SD20	29	32 ^{0} 34.680	117 ^{0} 11.450			x
SD21	29	32 ^{0} 36.990	117 ^{0} 12.690			x
RF3	27	32 ^{0} 32.270	117 ^{0} 11.000			x
RF4	27	32 ^{0} 25.910	117 ^{0} 17.655			x

[a] South Bay Water Recalamtion Plant (NPDES Permit No. CA0109045, Order No. 2000-129) and
International Wastewater Treatment Plant (NPDES Permit No. CA0108928, Order No. 96-50)

[b] Water sampling = bacteria, physical and chemical seawater parameters
Benthic sampling = sediments and macrobenthic invertebrates (Van Veen grab)
Fish sampling = otter trawls (demersal fish & megabenthic invertebrates) and rig fishing (fish)

[c] Station S0 replaced station S1 in 2002

Appendix E

Conductivity Temperature and Depth (CTD) Instrumentation

A description of the CTD system, its specifications, and calibration schedules for the integrated sensors. Included are examples of calibration sheets for dissolved oxygen, pH, pressure, and temperature

CTD Underwater Unit (fish: Models SBE-25, SBE-9)

The main pressure housing is composed of acetyl co-polymer plastic and is rated to a depth of 600 meters. The fish contains the main electronics, and digitizes the incoming sensor information at a rate of 24 scans per second for the SBE-9, and eight scans per second for the SBE-25. Both units can be used for real-time sampling or autonomous (RAM) recording. During real-time data acquisition the scan rates of both CTD models are internally averaged to four scans per second.

The SBE-25 system has an integrated memory module with one MB of internal memory for autonomous battery powered RAM operations. During RAM operations, the unit is powered by nine 1.5-volt nickel-cadmium (NiCad), or alkaline batteries, and all eight scans are averaged internally and recorded as one scan per second. Fully charged batteries can power the CTD for approximately four hours. At a scan rate of one scan per second the memory can record data uninterrupted for over four hours.

Two SBE-9 CTDs and one SBE-25 CTD are stand-alone units surrounded by a protective stainless steel cage. A second SBE-25 is integrated into the carousel sampler system. Although calibration of the CTD fish is not necessary, they are returned to Sea-Bird for routine maintenance as needed.

SEARAM Memory Module (Model SBE-17)

This semiconductor data-logging module permits autonomous battery powered operation of the SBE-9 CTD with data storage capability. The unit has 256K of memory, and a 600-meter depth range. It is powered by twelve 1.5-volt NiCad, or alkaline batteries.

The SBE-9 CTD data collection rate of 24 scans per second is electronically averaged internally to an effective rate of one data line per second. An external magnetic reed switch is provided to deactivate the module when not in use, thus conserving both power and memory.

Pressure Sensor (Sensometrics SP91PFS-500A)

This sensor is a silicon semiconductor strain gauge-type pressure transducer mounted inside the main CTD housing. The maximum depth range for this sensor is 340 meters (500 psi). The theoretical accuracy of this sensor is 0.1% of full scale, but practical accuracy expectations for depth measurements are approximately 0.05 meter over the depths sampled (10 - 120 m). Calibration of this sensor consists of checking the zero pressure value each day prior to field deployment and adjusting the value as necessary (See example below). The sensor is factory recalibrated at Sea-Bird Electronics Inc. annually.

Conductivity Sensor (Model SBE-4)

This is a modular, replaceable sensor utilizing a two terminal, platinum electrode, flow-through type cell contained in an anodized aluminum pressure housing. The absolute accuracy expectations for this instrument are 0.00111 S/m (Siemens per meter) per month guaranteed and 0.003 S/m per year (typical). The expected resolution of this instrument is 0.00004 S/m. The conductivity values in Siemens per meter are converted to salinity values in parts per thousand using the Seasoft software output portion of the program. Field calibrations are typically not performed on this sensor because of its proven long-term stability. However, the sensor is evaluated and recalibrated at Sea-Bird Electronics Inc. after six months of use.

Temperature Sensor (Model SBE-3)

This is a modular, replaceable sensor featuring a glass-coated thermistor bead, pressure protected by a 0.8 mm (outside diameter) stainless steel tube. The main body of the unit is an anodized aluminum pressure housing with a 3400-meter depth capability. Absolute accuracy is factory guaranteed to drift less than 0.001EC per 6-month period. The usable resolution is better than 0.0005E C at 12 samples per second. The response time is 72 milliseconds at one meter per second of water velocity. Field calibrations are not performed on this sensor due to its history of long-term stability and the inability to provide a laboratory or shipboard controlled environment critical to making precise measurement comparisons. This sensor is returned to Sea-Bird Electronics Inc. for recalibration and servicing after six months of use.

Dissolved Oxygen Sensor (Model SBE-13)

The SBE-43 is a “Clark” polarographic membrane manufactured by Sea-Bird Electronics Inc. The sensor provides *in situ* measurements of oxygen concentrations to a depth of 7000 meters. This new sensor is designed with an internal temperature sensor resulting in more accurate readings. Continuous polarization eliminates the wait-time for stabilization. The SBE 43’s measurement range is 120% of saturation in all natural waters fresh and salt. And the accuracy is 2% of saturation. Calibration stability is improved by an order of magnitude over older models, therefore requiring less frequent calibration. Calibration drift rates are less than 2% over 1000 hours.

The SBE-13 is a modular, replaceable sensor designed to provide *in situ* measurement of oceanic oxygen concentrations as deep as 3400 meters. It is a “Beckman” polarographic type dissolved oxygen sensor manufactured by Sensor-Medics, Inc. The measurement range of this sensor is 0-15 mL/L with an expected accuracy of 0.01 mL/L and a resolution of 0.01 mL/L. The response time for the computed dissolved oxygen is six seconds. This time lag in the oxygen data is compensated for by the Seasoft software where it is automatically realigned with the other measurements.

Calibration of this sensor requires a temperature controlled environment. The zero level oxygen current measurements are created by flooding the manifold chamber of the sensor with pure gaseous nitrogen. The CTD is then immersed in a vigorously aerated 100-gallon water bath and left undisturbed for 30 minutes, thereby ensuring complete temperature equilibration and oxygen saturation. Following the 30-minute equilibration, the saturated oxygen current measurement is taken. The two measurements are then entered into the Seasoft calibration routine in order to adjust the calibration constant values for the sensor. The newly calibrated sensor values are compared to a value obtained from a dissolved oxygen saturation table. This procedure is performed once a month, immediately prior to monthly water quality sampling (see Example below for an example of the calibration sheet). The sensor is returned to Sea-Bird Electronics Inc. when routine calibration indicates that factory servicing and evaluation are necessary.

pH Sensor (SBE-18)

This modular, replaceable, completely self-contained sensor has a depth range of 0 - 3400 meters. It is a combination type of pH sensor utilizing a pressure-balanced Teflon junction and a glass Ag/Ag-Cl reference electrode. This sensor measures pH in the range of 2-12 pH units with an accuracy of ±0.05. Calibration of the sensor is performed each day prior to sampling using precision buffer solutions of pH 7, 8, and 9 (See example below). The buffers used during calibration are discarded after each calibration is completed. The sensor is returned to Sea-Bird Electronics Inc. when routine calibration indicates that factory servicing and evaluation are necessary.

Transmissometer (WET Labs C-Star 25cm)

The transmissometer utilizes a modulated light-emitting diode (LED) to generate light that is projected through a narrow bandpass interference filter limiting the wavelength to 660 nm. This wavelength of light then passes through a beam splitter to provide reference light to measure LED performance. The remaining light continues on through the pressure window and interacts with the seawater sample over a 25 cm distance prior to reception by the detector.

The transmission range is 0 - 100% and the expected accuracy is $\pm$ 0.5%. This instrument is calibrated each day prior to sampling. The calibration value used is 95.77%, which is the equivalent air value for maximum light transmission in clean water at this path length. An example of a calibration sheet is included below. The sensor is returned to WETLabs Inc. when routine calibration indicates that factory servicing and evaluation are necessary.

Submersible Pump (Models SBE-5, SBE-5T)

This unit is a modular, replaceable, self-contained centrifugal pump with a maximum operating depth of 3400 meters. It features a 12 Volt DC motor with ball bearings and a magnetic drive with a pumping rate of 15 mL/sec. The pump improves the conductivity cell's response time and provides a uniform flow of water over the dissolved oxygen sensor. No calibration of this pump is necessary, however it is returned to Sea-Bird Electronics Inc. for routine servicing as needed.

Chlorophyll Fluorometer (WET Labs WETStar Miniature Fluorometer)

The WETStar fluorometer measures chlorophyll *a* concentration by measuring the fluorescence emission of an in-situ water sample. The unit uses two blue LEDs centered at a wavelength of 455 nm and modulated at 1 kHz to provide the excitation energy. Blue interference filters reject the small amount of red light generated by the LEDs. The 455 nm light then enters the sample, and in the presence of chlorophyll generates the emission of light at a wavelength of 685 nm. This light is then filtered from the scattered blue light by a red interference filter. The remaining 685 nm light is then detected by the Photo Diode Detector.

Chlorophyll *a* values measured by this unit should not be interpreted as an absolute measure of chlorophyll *a* concentration and primary productivity. Phytoplankton species can differ in their emission response by more than an order of magnitude, and even the physiological state of the phytoplankton will influence the emission response to a significant degree (Loftus and Seliger, 1975). The value of this instrument lies in its ability to corroborate fluctuations in other parameters such as transmissivity, dissolved oxygen and pH. The fluorometer is calibrated every six months. The sensor is returned to WETLabs Inc. when routine calibration indicates that factory servicing and evaluation are necessary.

LITERATURE CITED

FSLC (Field Sampling and Logistics Committee). (2003). Southern California Bight 2003 Regional Marine Monitoring Survey: Field Operations Manual. Southern California Coastal Water Research Project, Westminister, California, USA.